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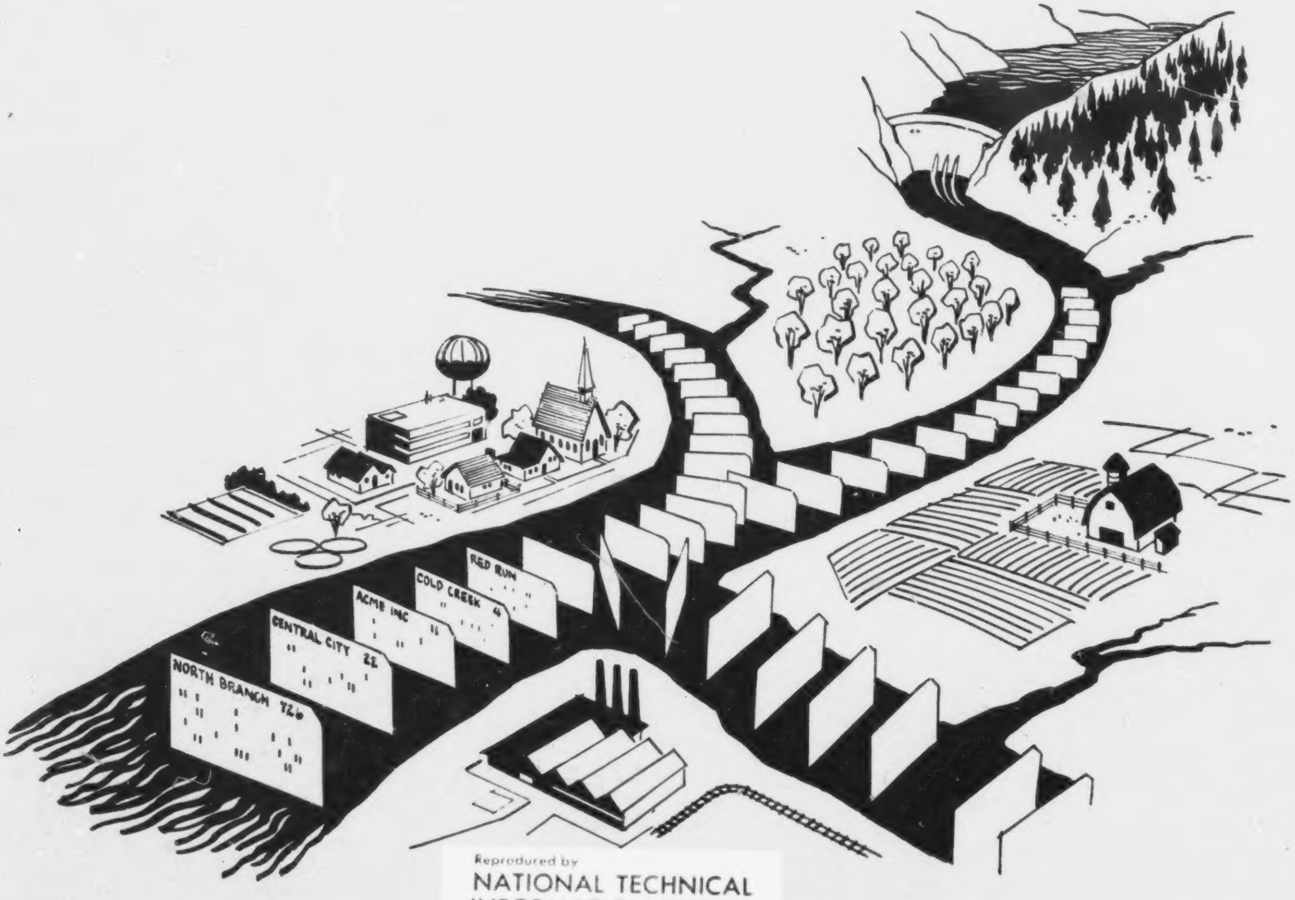
The Basin Model:

ECONOMIC SECTOR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SELECTED WATER RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

1. Report No. *2.* *3. Accession No.*

W 72-11274
~~72-10309~~

4. Title

THE RIVER BASIN MODEL: ECONOMIC SECTOR,

5. Report Date
6.
8. Performing Organization Report No.

7. Author(s)

10. Project No. EPA Program
16110 FRV 12/71-3

9. Organization

Envirometrics, Inc., Washington, D.C.

11. Contract/Grant No.

13. Type of Report and Period Covered

12. Sponsoring Organization Water Pollution Control Research Series

15. Supplementary Notes

~~Prepared for: Office of Research and Monitoring, U.S.~~ Environmental Protection Agency, ~~Project #16110 FRU, Contract # 14-12-959~~, December, 1971. 151 p, 43 fig, 6 tab, 1 append.

16. Abstract

The RIVER BASIN MODEL is not primarily a water management model. It is a human interaction, computer-simulation decision-making tool, representing the entire complex economic, social, and governmental activities occurring within a specified local system. Its users represent the major economic, social, and governmental decision-makers who cause the regional system to function on a year-to-year basis. As part of the functioning of this system, water is demanded by industries and municipal water suppliers and pollution is generated by manufacturing and commercial activities, by people, and by farm activities. The model provides computer programs which simulate the major processes. Model users provide inputs to these programs on behalf of business activities in the Economic Sector, groups of people or population units in the Social Sector, and government departments in the Governmental Sector. A gaming format is employed; Economic Sector teams control regional economic assets: cash, land, manufacturing plants, outside investments, commercial activities, and/or residences. Economic decision-makers are those businessmen who operate commercial, industrial, residential and farm establishments. Water decisions are made within their realistic context of interaction with the regional processes. Industrial activities use surface water and all other economic businesses have some need for municipally supplied water.

~~(See also W72-10309)~~ (Bell-Cornell)

17a. Descriptors

*Regional analysis, *Economics, *Water demand, *Water users, *Water pollution control, *Treatment, *Simulation analysis, *Computer programs, *Decision making, *Mathematical models, *Industries, *Farms.

17b. Identifiers

*Economic assets, *Gaming-simulation.

17c. COWRR Field & Group 06A, 06B, 06D, 05G

Copy available from GPO Sup Doc EP2.10:16110 FRV 12/71-3 $1.25 ; microfiche from NTIS as PB 210 561 , $0.95.

18. Availability

19. Security Class. (Report)
20. Security Class. (Page)
21. No. of Pages
22. Price

Send To:

WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D. C. 20240

Abstractor Janet Bell
Institution Cornell

The RIVER BASIN MODEL:

Economic Sector

by

Envirometrics, Inc.
1100 17th Street, N.W.
Washington, D.C. 20036

for the
Office of Research and Monitoring
Environmental Protection Agency

Project #16110 FRU
Contract #14-12-959

December, 1971

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $1.25

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ECONOMIC SECTOR MANUAL

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I. INTRODUCTION TO THE MODEL

A. Brief Description of the Model

In a sense, the RIVER BASIN MODEL is a misnomer because if one places an emphasis on "River" it leads one to believe that the model is primarily concerned with water management. The emphasis should be placed on "River Basin", and that term should be interpreted in its broadest context as meaning a geographical area of land. Through its two major components -- human interaction and computer simulation -- the model represents the economic, social and governmental activity that takes place within the geographical boundaries defined by the river basin or more simply by a group of continguous counties.

The model is unlike most other simulation of human interaction models. It was not designed to accomplish any one specific purpose. Rather it was designed to let its users represent the major economic, social, and governmental decision-makers who cause a regional system to function and change on a year-to-year basis. As part of the functioning of this regional system, water is demanded by industries and municipal water suppliers and pollution is generated by manufacturing and commercial activities, by people, and by farm activities.

The model is a computer-assisted decision-making tool, in which a number of computer programs simulate major processes that take place in the local system such as migration, housing selection, employment, transportation, shopping patterns,the allocation of leisure time, and water quality determination. Users of the model provide inputs to these programs on behalf of business activities in the economic sector, groups of people or population units in the social sector, and government departments in the government sector.

Normally, the users of the model are assigned decision-making responsibility for businesses, population units, and government departments in a gaming format. This means that users become members of teams that are assigned control of:

1. Economic Assets: cash, land, manufacturing plants, outside investments, commercial activities, and/or residences.
2. Social Assets: population units that are designated as high income, middle income, and/or low income.

3. Government Assets: power of the budget, taxing and assessing authority, service responsibility, and planning and regulatory power.

The computer print-outs for a year provide a detailed description of the regional area represented by the model, and the users of the model evaluate this status as individuals, as team members, and collectively to define problems, establish objectives, develop strategies, implement plans, and react to feedback from the new computer printout for the next year.

The initial starting position shows a particular set of allocations of the locals system's resources and their effects on the status of the local area. The users of the model evaluate their own particular status within the local system as well as the status of the area as a whole. They then interact with one another in a dynamic decision-making environment in which they collectively have control over the local water quality decisions that will be made, implemented, and reacted to. Some of the model players may have apparently only marginal interests in the local water quality issues because they are pre-occupied with running schools, building roads, earning incomes, producing manufactured goods, building housing, and supplying local goods and services. Others will have maybe more interest as they attempt to be elected into public office, run the planning department, collect taxes, recreate, and develop a generally pleasant environment for their new residential subdivisions. Still others might have a direct and pressing interest in the local water quantity and quality as they attempt to set and enforce water quality standards, supply municipal water, use surface water in their production process, and benefit from major water-based recreation areas.

In short, the entire local system is represented by the model and its users, and water decisions are placed within their realistic context of having different importance to different individuals as a function of their occupation, location, resources, and personal inclinations.

B. The Three Sectors

The model contains three basic decision-making sectors: economic, social and public. (Figure 1) Every city or region contains these three vital sectors whose interactions cause the area to function and to either grow and prosper or stagnate and decay. Decisions made by one group ultimately affect others

Figure 1

THREE DECISION-MAKING SECTORS AND CONSTITUENT TEAMS

ECONOMIC TEAMS
(Identified by single letter
codes: A, B, C, etc.)

INDUSTRIAL DECISION-MAKER

- HI-Heavy Industry
  - FL-Furniture and Lumber
  - SG-Stone Clay and Glass
  - MP-Primary Metals
  - MF-Fabricated Metals
  - NL-Nonelectric Machinery
  - EL-Electric Machinery
  - TE-Transportation Equipment

- LI-Light Industry
  - FO-Food
  - TA-Textiles and Apparel
  - PA-Paper
  - CR-Chemicals, Plastics and Rubber

- NS-National Service

COMMERCIAL DECISION-MAKER

- BG-Business Goods
- BS-Business Services
- PG-Personal Goods
- PS-Personal Services

RESIDENTIAL DECISION-MAKER

- RA-Single Family
- RB-Garden Apts. and Duplex
- RC-Multiple Unit and High Rise

GOVERNMENT TEAMS
(Identified by the specific
code preceding the department name)

CH-Chairman of Jurisdiction

CO-Councilman

AS-Assessment and Finance

SC-School

MS-Municipal Services

UT-Gas, Electric, Water and Sewer

HY-Highways

BUS-Bus Company

RAIL-Mass Transit Agency

PZ-Planning and Zoning

SOCIAL TEAMS
(Identified by double letter
codes: AA, BB, CC, etc.)

PH-High Income

PM-Middle Income

PL-Low Income

and one group often works against another group to achieve its goals. For example, proposed commercial developments by an economic group in a predominantly residential area can be blocked by residents of that area just as proposed changes by the government departments can be opposed by those participants in the economic or social sector.

1. The Economic Sector

Economic decision-makers are those businessmen who operate industrial, commercial, residential and farm establishments. Upon receiving output at the beginning of the round economic decision-makers review their economic status and make decisions for the present round. The various economic activities in the model have the following characteristics:

Basic Industry

Heavy Industry, Light Industry and National Services spend money for business goods and business services, utilities, a labor force, transportation, and taxes. In order to produce basic industry output which is then sold to the national markets at prices determined by national business conditions (the computer), owners of basic industries can make a wide variety of decisions. These decisions include purchasing land, changing salaries or maintenance levels, boycotting business goods and business services establishments, acquiring laons, building new businesses, upgrading existing businesses, demolishing old ones, and treating effluents that are dumped into the local water system.

The basic industry of the economy can be further subdivided into the following categories:

HI - Heavy Industry

FL - Furniture and lumber
SG - Stone, clay and glass
MP - Primary metals
MF - Fabricated metals
NL - Non-electrical machinery
EL - Electrical machinery
TE - Transportation equipment

LI - Light Industry

FO - Food
TL - Textile, apparel and leather
PA - Paper
CR - Chemicals, plastics, and rubber

NS - National Services

Commercial Establishments

Business goods (BG) and business services (BS), personal goods (PG) and personal services (PS) spend money on many of the same items as basic industry in order to maintain a level of service capacity. This service capacity is consumed or partially consumed by local customers which include: the industrial sector, other commercial establishments and the population units (Pl's) who live in the city. Owners of the commercial establishments may make most of the decisions that owners of basic industries make in addition to setting prices for their products.

Residences

Single-family (RA), townhouse (RB), and high-rise (RC) residence units spend money on personal goods and personal services, utilities, and taxes, and earn income based on rent charged and the number and type of occupants residing in their housing units. Owners of residences may make the same types of decisions made by owners of basic industry in addition to setting the rent paid by their tenants.

Farms

Farm owners make very few decisions aside from how their land will be utilized and what level of fertilizer use they will employ.

2. The Social Sector

Decision-makers in the social sector represent the citizens who live and work in the simulated area. People are represented in terms of population units (Pl's). Each population unit represents fixed numbers of people (500). Population units are divided into three socio-economic groups: high income (PH), middle-income (PM) and low-income (PL). Because each class possesses its own expectations and behavioral patterns, each will have different preferences for residence, job, and schooling, etc. Social decision-makers can vote on behalf of the Pl's which they represent. Voting power is dependent upon the number of population units controlled, the number of registered voters in each, and their socio-economic class. Social decision-makers can also direct the population units under their control to boycott places of employment or shop locations. Social decision-makers can also allocate leisure time of their population units to be spent in any of four basic activities: extra work, adult education (public or private), politics, and recreation. The amount of time spent on each of these activities has an effect on the socio-economic status and/or the dissatisfaction index of people living within the city.

A significant part of the model centers around how Pl's function within the local system during the course of each round of play which represents one year of time in the local area. Figure 2 shows the actions of Pl's as they are affected by the major operating programs.

3. The Public Sector

In the model, the government sector deals with the problems of education, highways, municipal services, planning, zoning, utilities, water supply and quality and bus and rail transportation. The public sector is divided into two basic components. The first component includes elected officials: the Chairman and the Council. These officials are elected by the social decision-makers representing the people who live in each jurisdiction. The Chairman and Council set tax rates, approve budgets, grant subsidies and appropriations, and make appointments. Appointed officials named by the Chairman are heads of these six governmental departments: Assessment (AS), Schools (SC), Municipal Services (MS), Highway (HY), Planning and Zoning (PZ), and Utilities (UT). The Bus and Rapid Rail Companies are semi-private organizations which also may be appointed by the Chairman. Players representing these departments make decisions which include allocating capital and current funds, changing salaries and maintenance levels, requesting federal-state aid, changing district boundaries, constructing or demolishing public buildings, upgrading public buildings, changing levels of service, and transferring cash between accounts.

Figure 2

Example of How Population Units Are Affected by the Major Operating Programs of the Model

Major Operating Programs	Effect on Population Unit
Migration	Pl's move to the local system, find and change housing within the local system, leave the local system
Water System	Poor water quality incareses dissatisfaction and high coliform count increases health costs and time lost due to illness.
Depreciation	Housing that depreciates becomes less attractive in the migration process.
Employment	Pl's are assigned to full and part time jobs that maximize net income (salary minus transportation costs), employers search for best educated workers.
Transportation	Pl's travel to work by the mode and route that minimizes total costs (dollar plus time), Pl's travel to shopping along the minimum cost routes.
School Allocation	Students of Pl's are assigned to public or private schools based upon the quality of public schools.
Park Allocation	Pl's are assigned to parks within a specified distance of where they live.
Time Allocation	Involuntary expenditures of leisure time are calculated as a function of the success of getting part time jobs, public adult education and the time spent on transportation.
Commercial Allocation	Pl's are assigned to stores at which the total costs are minimized (price plus transportation to the store).

C. The Water Component

The water component is a subsector that, in a sense, cuts across the other three sectors or is a part of each. For example, some of the industrial activities in the economic sector use surface water in their production process and all other economic businesses have some need for municipally supplied water. Population units in the social sector use water as a function of their income class and the type of housing they inhabit. In the government sector, the Utility Department is responsible for supplying the municipal water needs of the residents of its jurisdiction.

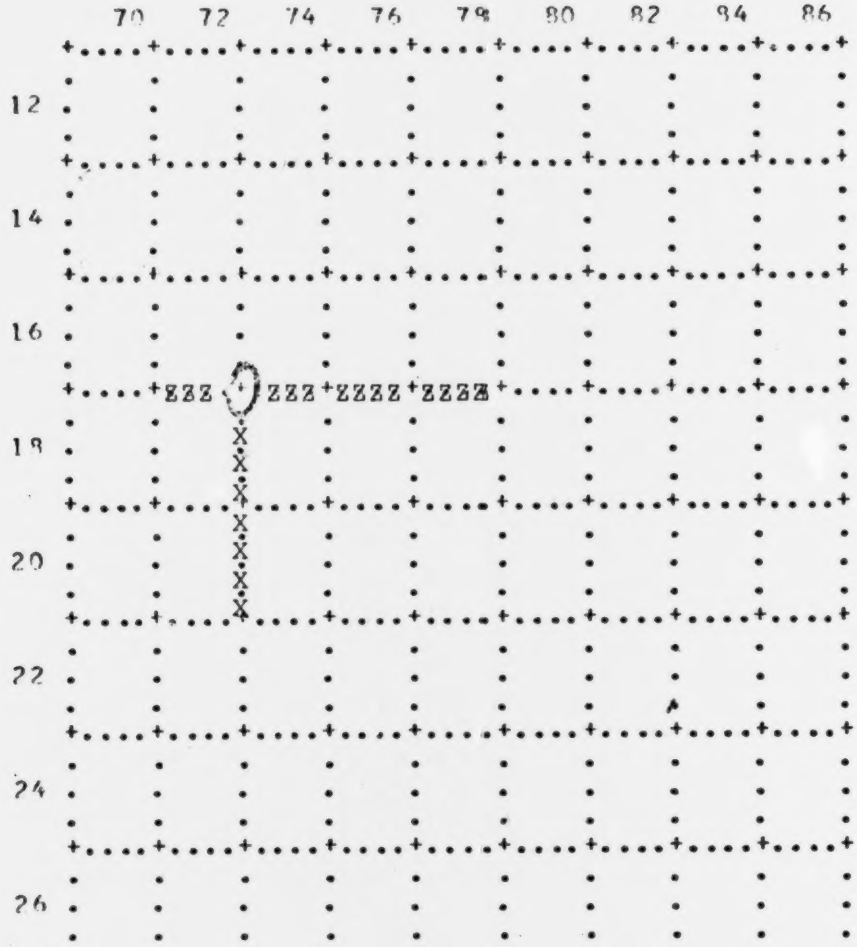
Each of the surface water users requires a specified quality of water and must either treat the water they intake or purchase water from a source outside of the local system. Every water user adds some pollutants to the water it returns to the water system. If left untreated, these water discharges may lower the quality of water of the body of water into which they are dumped. Since water users and polluters are located in a geographical space, acitivities upstream and downstream are affected differently by the dynamically created water quality conditions.

D. The Local System

The particular regional configuration being used is represented on a grid map consisting of 625 squares. Each square is of equal size and represents 6.25 square miles, 2.5 miles on a side. The grid and all of the computer maps are keyed to a coordinate system. Each parcel can be identified by its coordinates. Horizontal coordinates range from 70 to 118 and vertical coordinates from 12 to 60. Intersections are identified by the odd-numbered coordinates and highways are identified by even-odd (east-west) or odd-even (north-south) coordinates. In all cases, the horizontal coordinate (i.e., the larger number) is identified first.

For example, on the map in Figure 3 the shaded parcel is identified as 7014. Further, the four mile highway indicated by ZZZ is identified as 7217, 7417, 7617, 7817, while the two mile highway indicated by XXX is identified as 7318, 7320. The intersection marked by 0 is located at 7317.

Figure 3



E. The Unit of Time -- A Round

In the model, a round represents a year of change in the life of the simulated area. From the standpoint of the participants, however, a round may be thought of as a decision-making cycle which starts when they receive their computer output and ends when they hand in their decision input forms for processing by the computer.

During the early part of the typical round, decision-makers will be simultaneously reviewing their computer output and attempting to organize their possible actions. Economic decision-makers, for example, will probably attempt to acquire parcels of land that look good for future development purposes. They may attempt to secure loans from local or outside sources, apply for zoning changes, request utility expansions, and lobby for increased highway access. At the same time, social decision-makers might be bargaining for higher wages, requesting improvements in local schools and municipal services, lobby for higher water quality in the local river, and trying to promote those politicians who see things their way.

Meanwhile, the governmental decision-makers may be receiving requests from the economic and social decision-makers to lower taxes, improve schools, provide better municipal services, expand highways, build additional utilities, enlarge the park system, and improve other services. Budget officials are faced with the task of finding additional revenue to meet expanding public needs and dividing appropriations among the many local departments, all of which have attempted to justify their expanding budgets. Also the government office concerned with water quality might be pressuring the polluting industries to treat their wastes or face regulatory action. All water users might be concerned with water quality and quantity in so far as it affects their cost of using water and doing business.

Toward the middle of the round, it becomes clear to many decision-makers that all of their requests will not be granted. Thus, trade-offs and bargains must be made. Elected officials will begin to worry about staying in office. Departments must often plan to operate with less funds than they had requested. Low income representatives attempt to make their political power felt. High-income representatives attempt to maintain their status. Businessmen begin to look for short-cuts to reduce their losses and increase their activity and profit-making ventures. The water quality office begins to act upon its earlier threat.

As the round approaches a conclusion, the participants formalize the bargains they have made, continue to fill out their decision forms, terminate the negotiations on new wage levels, new prices and new rents, carry on their boycotts and complete any other possible actions. All water related decisions by the private and public decision-makers are completed. Treatment plants are built, industries shut down, fine levied, sampling stations constructed, etc.

When the round ends, participants campaign and carry out new elections, hold town meetings, debrief their actions, and develop new strategies while the computer performs its functions and prepares new output on the status of the simulated city.

F. The Function of the Computer

In the model, players are able to exercise a number of decision alternatives. Only some of these will be communicated to the computer, the rest will be part of the constant communication, bargaining and negotiating carried out in the game-room itself.

The computer performs several major functions in the model.

First, it stores all the relevant economic, social and governmental statistics for the area; updates data when changes are made; and prints out yearly reports on the status of the local system and reports for the economic, social, and government decision-makers.

Second, the computer simulates the actions of the outside system. For example, the computer simulates both a national business cycle, the probabilities of federal-state aid and interest rates on most loans.

Third, the computer performs certain routine functions or processes that would be time-consuming if the players themselves were to perform them. For example, the computer assigns workers from population units to jobs under the assumption that workers will attempt to earn as much money as possible. Other processes include assessing all property, assigning buyers of goods and services to shop at particular commercial establishments, assigning children to public or private schools based upon the capacity and quality of the public schools, and assigning population units to residences based on their desirability. The computer also simulates the migration process which moves population units into, out of, and within the local system. It also measures all of the types of pollution at all points along the river system and calculates a comprehensive water quality index.

ECONOMIC SECTOR

II. Introduction to the Economic Sector

This manual contains the basic information and description of the model required by the Economic Sector. It is assumed that the Model Overview and the Scenario descriptions have been read prior to the receipt of this manual.

Once the players comprising the Economic Sector have become familiar with the model in general, the particular city being represented, and the workings of the local economic, social and government system, they will be able to bring their own imagination and initiative to bear on the use of the resources they own.

Economic teams are given the opportunity and responsibility for operating and creating any growth in the economic resources of the local system. Players in this sector have the chance to use this opportunity in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by government officials, the local citizenry, and the rest of the business community.

A. Economic Sector Summary

The teams in the Economic Sector represent the private owners of land and businesses in the local system. An economic team (identified by a single letter A, B, C, etc.) is distinguished from other decision-makers in the model by the fact that they own private property. They own land, for example. Some of this land is developed and some is undeveloped. The ownership of developed land gives the economic decision-maker the responsibility of operating the developments which are located there. Another asset of the economic decision-maker is cash. Teams may use this cash to acquire new land, build new businesses, upgrade old ones, invest in stocks, and others. In the local system, the economic decision-makers while often concentrating on maximizing their own profit, find that their decisions, biases and judgments will greatly influence and change the local system.

Economic teams interact with the social sector in that the economic teams (basic industries and commercial establishments) employ population units and set salary levels, supply housing quantity and quality and set rent levels, and provide personal goods and services for purchase by population units and set prices. The social teams that control the local system population may take actions against economic teams if they think salaries are too low, rents are too high, housing is in bad shape, or costs are out of line.

Economic teams interact with the government sector in that they require zonong approval, utilities, water supply, and transportation access to undertake certain developments. The government sector, in turn, is dependent in large part on the economic sector for local tax revenue.

Teams are free to set any objectives for themselves. They may take an active or passive concern in the local system's social problems, water quality issues, and government operation in general.

III. COMPUTER PRINTED OUTPUT DESCRIPTION

A. Introduction

The printed computer output provides a yearly report of the status of the simulated region and of interactions within the region during the previous year. There are several types of output: maps showing characteristics of the region which differ geographically; summaries which present information in capsulated form; and detailed information from which the summaries are derived.

The figure on the next page shows the titles of the output sections in the order in which they are printed. That sequence follows neither the logical order of computer program operations nor the usual sequence in which a user examines the output. The code number beside the title of each section of output listed in this figure is the code number used in all examples of output included in this manual. The output is explained in this section in order of most general to most detailed information. Output is explained in the following order:

- maps
- summary information
- general information of relevance to all three sectors
- social sector detail
- economic sector detail
- government sector detail

There are a few standard features of all printed output sections. Each has a title which is a short description of the type of information given by the section of output. Each also contains both the round number and the game heading (the name of the data base being used or some other heading input by the director). Where relevant, a jurisdiction number is also printed.

After a few rounds' experience with the model, a model user usually needs only the printed computer output from a round and the Master Tables and input formats contained in this manual in order to play subsequent rounds.

RIVER BASIN MODEL OUTPUT

1. **Migration**
    - 1.1 Environmental Indexes
    - 1.2 Personal Indexes
    - 1.3 Dissatisfaction Cutoffs
    - 1.4 Migration Detail
    - 1.5 Migration Statistics
    - 1.6 Migration Summary

2. **Water System**
    - 2.1 Water User Effluent Content
    - 2.2 River Quality During Surface Water Process
    - 2.3 Water User Costs and Consumption
    - 2.4 Coliform and Pollution Index Values

3. **Employment**
    - 3.1 Employment Selection Information for PL Class
    - 3.2 Employment Selection Information for PM Class
    - 3.3 Employment Selection Information for PH Class
    - 3.4 Part-Time Work Allocation for PH Class
    - 3.5 Part-Time Work Allocation for PM Class
    - 3.6 Part-Time Work Allocation for PL Class
    - 3.7 Employment Summary

4. **Commercial Allocation**
    - 4.1 Personal Goods Allocation Summary
    - 4.2 Personal Services Allocation Summary
    - 4.3 Business Goods Allocation Summary
    - 4.4 Business Services Allocation Summary
    - 4.5 Government Contracts
    - 4.6 Terminal Demand and Supply Table
    - 4.7 Terminal Allocation Map

5. **Social Sector**
    - 5.1 Dollar Value of Time
    - 5.2 Social Decision-Maker Output
    - 5.3 Social Boycotts

6. **Economic Sector**
    - 6.1 Farm Output
    - 6.2 Residence Output
    - 6.3 Basic Industry Output
    - 6.4 Commercial Output
    - 6.5 Economic Boycott Status
    - 6.6 New Construction Table
    - 6.7 Land Summary
    - 6.8 Loan Statement
    - 6.9 Financial Summary

7. **Social and Economic Summaries**
    - 7.1 Number of Levels of Economic Activity Controlled by Teams
    - 7.2 Employment Centers
    - 7.3 Economic Control Summary for Teams
    - 7.4 Social Control Summary for Teams
    - 7.5 Social Control Summary Totals
    - 7.6 Economic Graphs for Teams
    - 7.7 Social Graphs for Teams

8. **Government Detail**
    - 8.1 Assessment Report
    - 8.2 Water Department Reports
    - 8.3 Sampling Station Report: Point Source Quality
    - 8.4 Sampling Station Report: Ambient Quality
    - 8.5 Utility Department Report
    - 8.6 Utility Department Finances
    - 8.7 Municipal Services Department Report
    - 8.8 Municipal Services Department Finances
    - 8.9 Municipal Services Department Construction Tabl
    - 8.10 Planning and Zoning Department Report
    - 8.11 School Department Report
    - 8.12 School Department Finances
    - 8.13 School Department Construction Table
    - 8.14 Highway Department Finances
    - 8.15 Highway Department Construction Table
    - 8.16 Rail Company Report
    - 8.17 Bus Company Report
    - 8.18 Chairman Department Finances
    - 8.19 Tax Summary
    - 8.20 Financial Summary

9. **Summary Statistics**
    - 9.1 Demographic and Economic Statistics

10. **Maps**
    - 10.1 Personal Goods Allocation Map
    - 10.2 Personal Services Allocation Map
    - 10.3 Business Commercial Allocation Map
    - 10.4 Municipal Service Map
    - 10.5 School Map
    - 10.6 Utility Map
    - 10.7 Water Usage Map
    - 10.8 Water Quality Map
    - 10.9 Municipal Treatment
    - 10.10 Municipal Intake and Outflow Point Map
    - 10.11 Surface Water Map
    - 10.12 Farm Runoff Map
    - 10.13 River Basin Flood Plain Map
    - 10.14 Farm Map
    - 10.15 Farm Assessed and Market Value Map
    - 10.16 Market Value Map
    - 10.17 Assessed Value Map
    - 10.18 Economic Status Map
    - 10.19 Highway Map
    - 10.20 Planning and Zoning Map
    - 10.21 Parkland Usage Map
    - 10.22 Socio-Economic Distribution Map
    - 10.23 Demographic Map
    - 10.24 Social Decision-Maker Map
    - 10.25 Topographical Restriction Map
    - 10.26 Government Status Map

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B. Map Output

The model output includes several maps which visually represent characteristics of the simulated region which differ by location. The entire simulated region is represented on a single, two-page computer map. A map key is printed at the bottom of each page. Map symbols appear on a map in the three types of locations which can be specified in the model: parcels (squares), parcel edges (lines separating squares), and intersections of lines (parcel corners). Land uses and other characteristics of parcels are represented within the squares. Divisions between parcels such as roads or jurisdiction boundaries are represented between parcels, and activities such as terminals are represented at parcel corners.

The Map Titles and a brief description of their contents are given below, in the order in which they will be discussed. All information is located spatially.

Economic Status Map: economic owners, economic activities and operating levels, zoning, levels of utilities installed, amounts of undeveloped land, road types, terminal levels, jurisdiction boundaries.

Government Status Map: school levels, parks, municipal service levels, utility plant levels, road types, terminal levels, jurisdiction boundaries.

Socio-Economic Distribution Map: residence types and levels, number of P1's of each class, road types, terminal levels, jurisdiction boundaries.

Demographic Map: populations, residential quality indexes, business value ratios, percent occupancy, road types, terminal levels, jurisdiction boundaries.

Personal Goods Allocation Map: PG shopping location for each class and residence, PG location.

Personal Services Allocation Map: PS shopping location for each class and residence, PS location.

Business Commercial Map: BG and BS shopping location for each business, BG and BS locations.

Utility Map: utility units served, utility units installed, utility plants, utility district boundaries, jurisdiction boundaries.

Surface Water Map: volumes of surface water, rates of flow, land area in water, directions of surface water flow, lakes.

Municipal Treatment Plant Map: municipal water intake treatment plants and levels, municipal sewage treatment plant types and levels, utility plant locations and code numbers, directions of surface water flow, utility district boundaries, lakes.

Municipal Inflow and Outflow Point Map: Municipal surface water intake points, municipal sewage outflow points, utility districts served by each, surface water qualities, directions of surface water flow, utility district boundaries, lakes.

Water Quality Map: economic activities and operating levels, surface water qualities, directions of surface water flow, lakes.

Economic Sector Water Usage Map: economic activities and operating levels, amounts of recycling, business effluent treatment types and levels, utility district boundaries, jurisdiction boundaries.

Municipal Services Map: economic activities and operating levels, municipal service units required, municipal services and their use indexes, municipal service district boundaries, jurisdiction boundaries.

School Map: numbers of public school students, numbers of private school students, schools and their use indexes, school district boundaries, jurisdiction boundaries.

Highway Map: economic activities and operating levels, road types, terminal levels.

Planning and Zoning Map: zoning, park, public institutional land uses, road types, terminal levels, jurisdiction boundaries.

Parkland Usage Map: parks, populations served by park, park use indexes, road types, terminal levels, jurisdiction boundaries.

Market Value Map: market values of all non-farm land, privately owned buildings, and privately owned land and buildings, road types, terminal levels, jurisdiction boundaries.

Assessed Value Map: assessed values of non-farm privately owned land and buildings, road types, terminal levels, jurisdiction boundaries.

Farm Assessed and Market Value Map: assessed and market values of farms, amount of land in farms, road types, terminal levels, jurisdiction boundaries, lakes.

Farm Map: farm owners, amount of land in farms, farm types, levels of fertilization, road types, terminal levels, jurisdiction boundaries.

Farm Runoff Map: where runoff from farms flows, direction of surface water flow, lakes.

River Basin Flood Plain Map: river basins, dam priorities, flood susceptibility of each parcel, direction of surface water flow, lakes, jurisdiction boundaries.

Topographical Restriction Map: topographically undevelopable land, road types, terminal levels, jurisdiction boundaries.

Social Decision-Maker Map: social decision-maker controlling each class living on each residence parcel, road types, terminal levels, jurisdiction boundaries.

1. Economic Status Map

This map shows the economic sector owners of all privately-owned non-farm parcels and the economic activity, if any, on each parcel. A parcel can have only one economic owner and one economic activity. Owners of farm parcels are shown on the Farm Map. The types of economic activities represented in the model are listed in the Master Tables.

The economic owner of a parcel owns all of the land and developments on the parcel which do not belong to the government or which are not topographically undevelopable. If the economic owner sells land to another economic decision-maker, he must sell all of the privately-owned land and buildings on the parcel to the new owner. An economic decision-maker can sell any portion of undeveloped land on a parcel to a government department.

The Planning and Zoning Department may zone parcels. Zoning is a restriction on economic development. Once a parcel is assigned a particular zoning code, all new economic development on the parcel must conform to the new zoning. If a parcel is unzoned, there is no restriction on what type of activity may be constructed on it. The Economic Status Map key defines what private land uses are allowed under each zoning code.

When a new economic development is constructed on a parcel, it must not only conform to the parcel's zoning; it must have sufficient utility service. Utilities are installed by the Utility Department in "levels" (1 - 9). Each level of economic activity requires a certain number of utility units, and each level of utility service supplies a fixed number of utility units to a parcel.

If an economic decision-maker has insufficient utility service for a proposed development, the Utility Department must install adequate utility service before the new development can be constructed.*

---

*There are two exceptions to the utility restriction on development: 1) RA housing can be built with "private utilities", which do not require utilities supplied by the Utility Department; 2) the director can override the utility restriction on individual developments.

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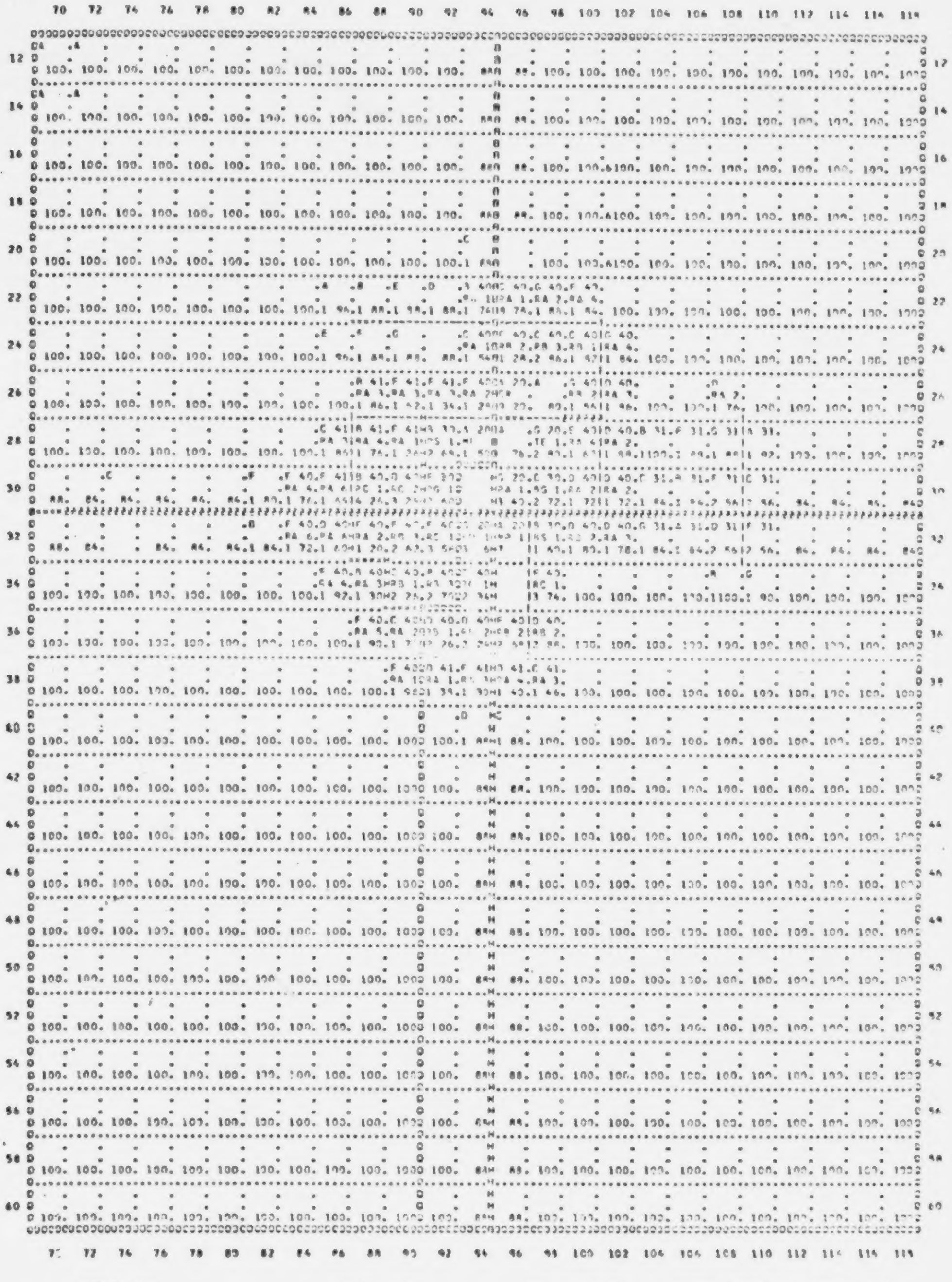
Figure 10.18

```
TWOCITY
                         ECONOMIC STATUS MAP                         ROUND  2
```



```
      PARCEL KEY                    PARCEL EDGES                 INTERSECTIONS          ZONING  LAND USE    ZONING  USE
TOP LEFT:     OWNER             .. .. ROADBED                * TYPE 1 TERMINAL        --   ANY USE          33  RS
TOP RIGHT:    ZONING            -- II TYPE 1 ROAD            X TYPE 2 TERMINAL        10   ANY BUSINESS     34  PG
MIDDLE:       LAND USE AND LEVEL == HH TYPE 2 ROAD           # TYPE 3 TERMINAL        20   HI,LI,CI         35  PS
BOTTOM LEFT:  UTILITY LEVEL     ZZ ** TYPE 3 ROAD                                     21   HI               60  RA,RB,RC
BOTTOM RIGHT: % UNDEVLPD LAND   OO OO JURISDICTION BOUNDARY                          22   LI               61  RA
                                                                                     23   CI               62  RB
                                                                                     30   HS,RG,RS,PG,PS   63  RC
                                                                                     31   HS               90  PARKLAND
                                                                                     32   RG
```

Economic developments also require land. Each activity, depending on its type, requires a certain amount of land for each constructed level of development. Regardless of the operating level of an activity, the land consumed is that of the constructed level, which is always greater than or equal to the operating level. The amount of privately-owned land which is not in developments is classified on this map as undeveloped. If a parcel shows no undeveloped land, no further economic development can occur there unless the owner either acquires more land from a government department owning a portion of the parcel or demolishes existing economic developments. An economic decision-maker can acquire land by purchasing a parcel from another economic decision-maker or by bidding on land which is owned by the Outside.

The operating level of an economic activity is shown on the Economic Status Map. For most purposes, a business' operating level is the only level considered by the computer programs. However, a business pays property taxes and maintenance for its constructed level.

2. Government Status Map

Whereas there can be only one economic owner per parcel, any combination of government departments can own developed and undeveloped land on a parcel. The government departments which can own land, and the types of developments each can construct on a parcel are:

Department	Development Type
Utility Department	Utility Plant Water Intake Treatment Plant Sewage Outflow Treatment Plant: Chlorination Primary Treatment Secondary Treatment Tertiary Treatment
School Department	School Unit
Municipal Service Department	Municipal Service Unit
Planning and Zoning Department	Parkland Public Institutional Land
Highway Department	Road* Terminal*

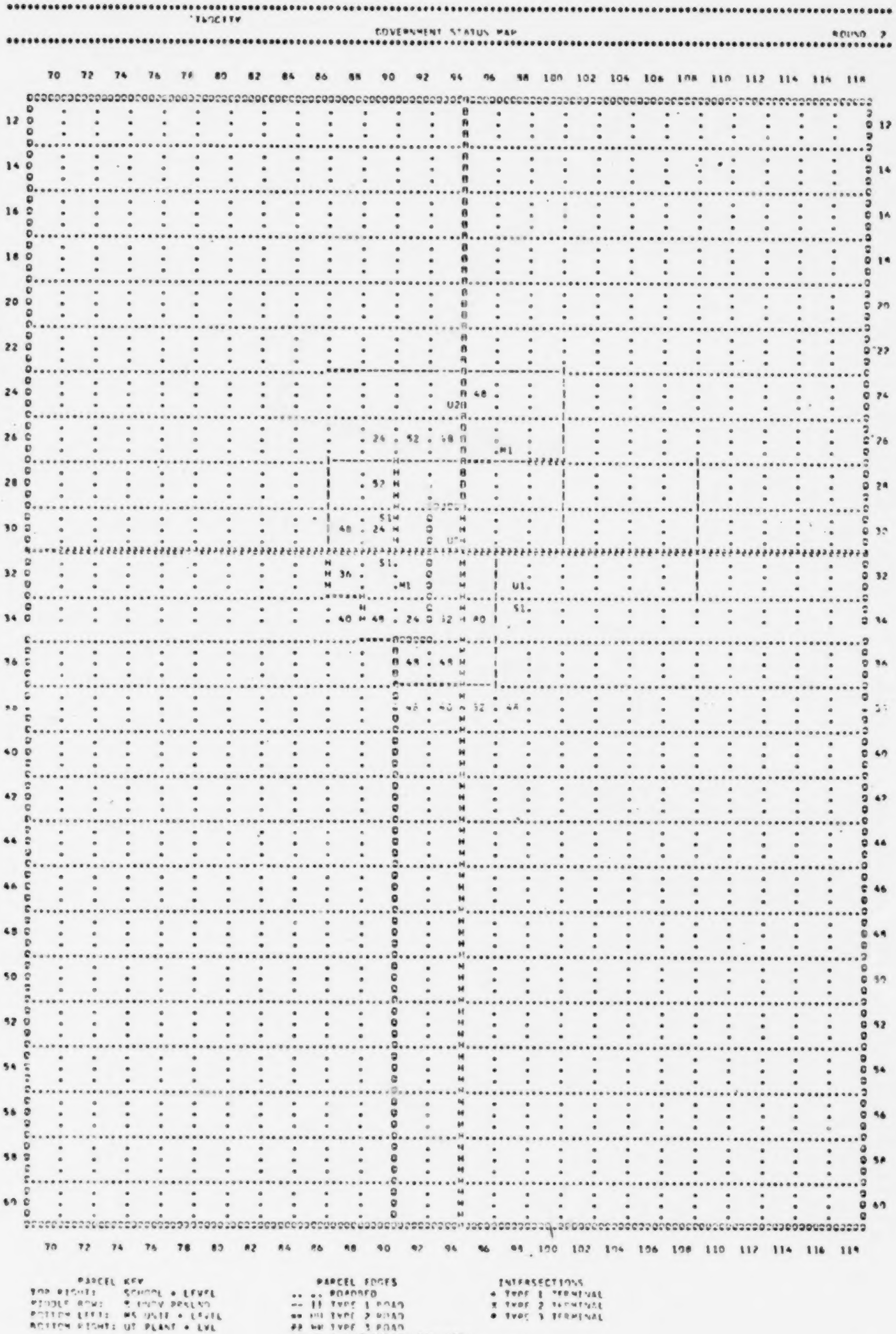
A government department can sell undeveloped land which it owns to either another government department or to the economic decision-maker owning the privately-owned portion of a parcel.

The government status map shows the locations of some of the types of government activities: schools, parks, utility plants, and municipal service units.

---

*A road requires land from the parcels on each side, and a terminal requires land from the four parcels touching the intersection at which it is located.

Figure 10.26


TAXCITY
GOVERNMENT STATUS MAP
ROUND 2
PARCEL KEY
TOP RIGHT: SCHOOL + LEVEL
MIDDLE ROW: % EMPY PRSLND
BOTTOM LEFT: MS UNIT + LEVEL
BOTTOM RIGHT: UT PLANT + LVL
PARCEL EDGES
.. .. BOARDED
-- II TYPE 1 ROAD
== UU TYPE 2 ROAD
## HH TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
* TYPE 3 TERMINAL

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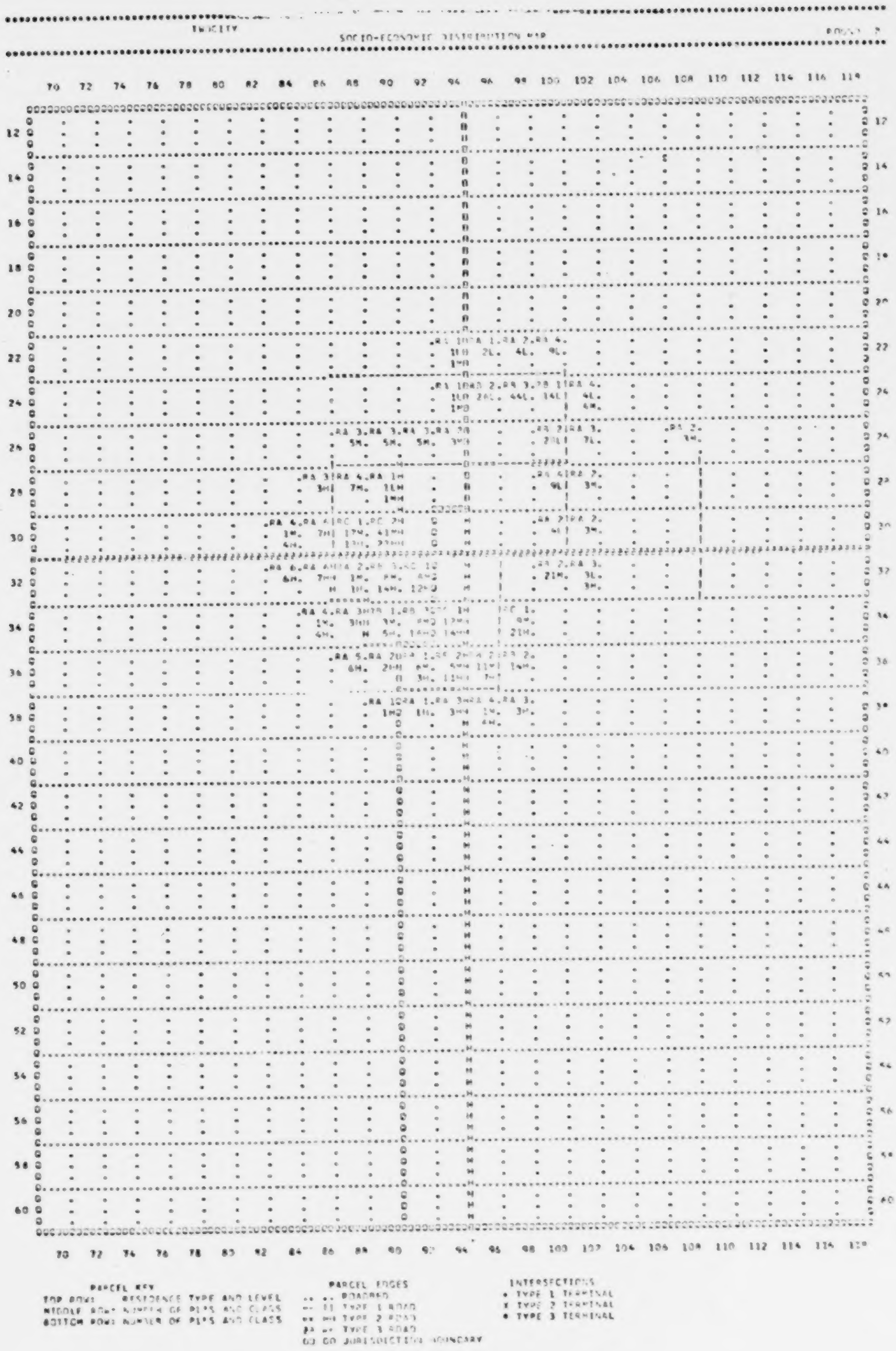
3. Socio-Economic Distribution Map

This map shows the number of Pl's of each class living on each residence parcel. The residence type and level are also printed.

The migration process allocates people to housing. Only two classes can live on a residence parcel simultaneously, due in part to the model's restriction that a PH will not move into a residence with a quality index below 71 and a PL will not move into housing with a quality index above 70. It is possible, if a residence depreciates below the minimum that a class will accept, that high-income, for example, will live in a residence with a quality index below 71 if the class was living on the parcel before the depreciation. In no case, however, can PH's reside on the same parcel with PL's.

Each level of a residence type provides a fixed number of space units. A Pl occupies a fixed number of space units, depending on its class. The percent occupancy of each residence is shown on the Demographic Map.

Figure 10.22


TWICITY
SOCIO-ECONOMIC DISTRIBUTION MAP
PARCEL KEY
TOP ROW: RESIDENCE TYPE AND LEVEL
MIDDLE ROW: NUMBER OF PIPS AND CLASS
BOTTOM ROW: NUMBER OF PIPS AND CLASS
PARCEL EDGES
.. .. ROADBED
-- II TYPE 1 ROAD
** HH TYPE 2 ROAD
== TYPE 3 ROAD
GG GG JURISDICTION BOUNDARY
INTERSECTIONS
• TYPE 1 TERMINAL
X TYPE 2 TERMINAL
• TYPE 3 TERMINAL

4. Demographic Map

The demographic map shows the number of people living on each residence parcel, the percent occupancy of each residence and the quality of all privately owned buildings and equipment.

Overcrowding (over 100% occupancy) contributes to a residence's neighborhood index and to the health index.

The quality is expressed as the quality index for a residence and as the value ratio for non-residential activities. A value ratio is the ratio of the present condition of a business' buildings and equipment to their original condition, expressed as a percent.

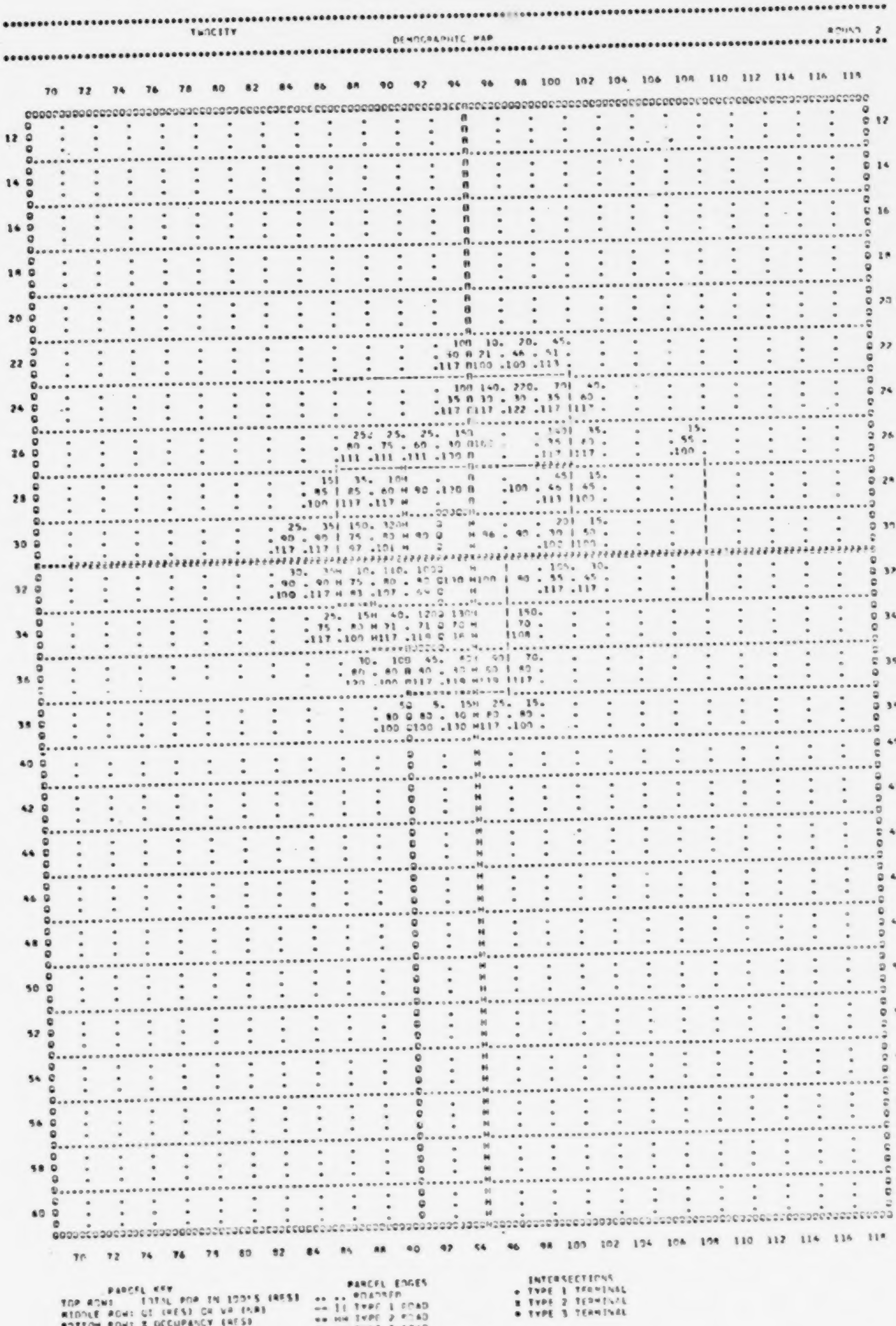
A quality index is somewhat different. Whereas a new business has a value ratio of 100, a new residence can have a quality index from 40 to 100.

Each year buildings and equipment depreciate in response to several conditions which vary by type of activity (see the Master Tables for the causes of depreciation). A business's depreciation is measured as a percent of original value (100). A residence's depreciation is measured as a percent of the original value of such a type of residence originally built at a quality index of 100, regardless of the original quality of the specific residence. Thus, business depreciation is a percent of original value but residential depreciation is a percent of quality index 100.

The owner of an activity can set a maintenance level for the activity. The maintenance level is the quality index or value ratio at which the owner will maintain the activity, regardless of how much it depreciates in a year. Not until the activity's value ratio or quality index falls to its maintenance level does the owner incur maintenance expenditures. The computer program depreciates and maintains buildings and equipment and charges the owner for the maintenance cost.

The Demographic Map shows quality indexes and value ratios after depreciation and after any maintenance.

Figure 10.23


TWOCITY
DEMOGRAPHIC MAP
ROUND 2
PARCEL KEY
TOP ROW: TOTAL POP IN 100'S (RES)
MIDDLE ROW: QI (RES) OR VA (NR)
BOTTOM ROW: % OCCUPANCY (RES)
PARCEL EDGES
.. .. BOARDER
-- II TYPE 1 ROAD
** HH TYPE 2 ROAD
ZZ ## TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
* TYPE 1 TERMINAL
X TYPE 2 TERMINAL
* TYPE 3 TERMINAL

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5. Personal Goods Allocation Map

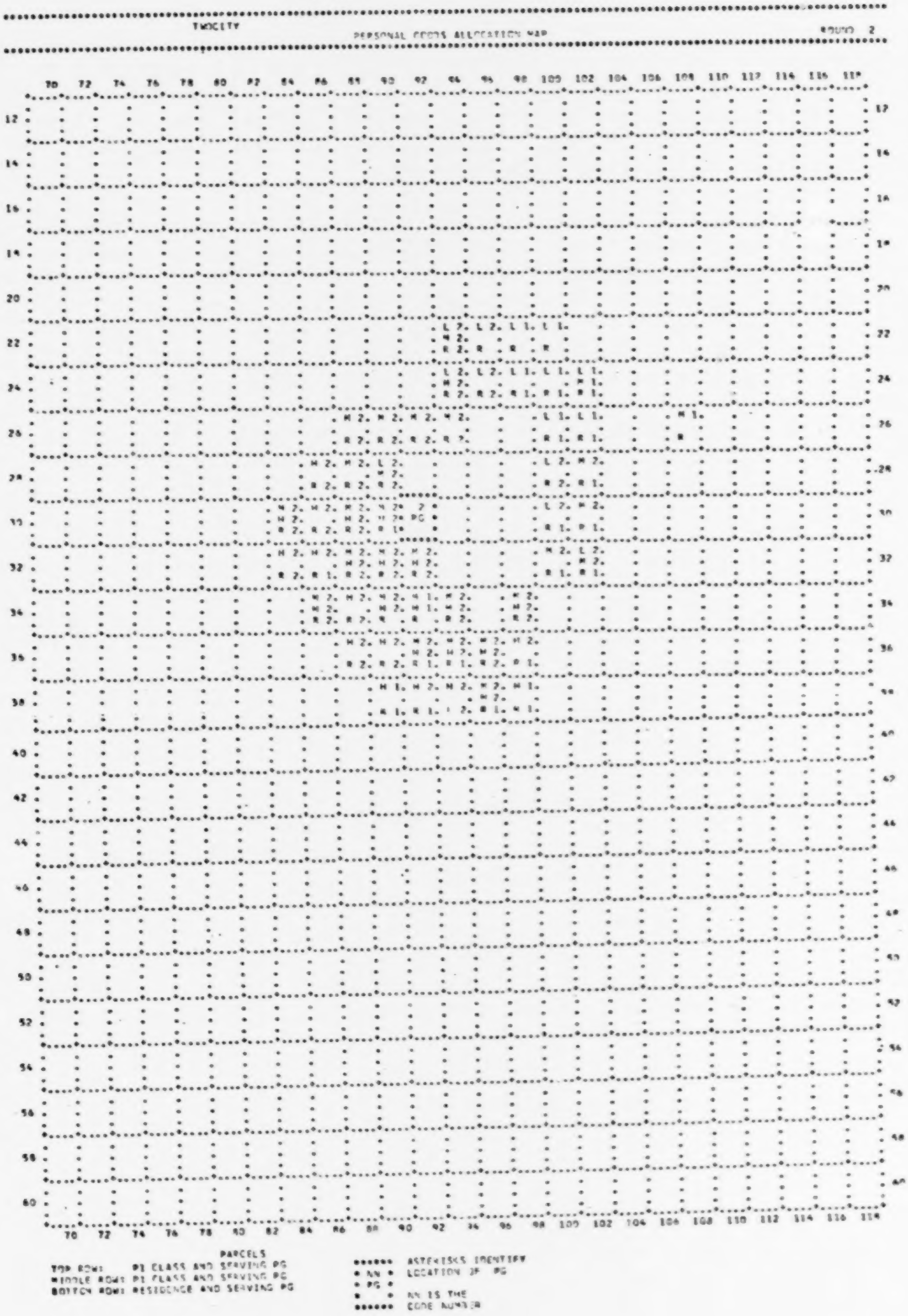
This map identifies the location of Personal Goods establishments and identifies the PG establishments that serve the customers from each parcel of land that has residences on it. PG establishments are located on those parcels that are encircled by asterisks. Their code number is also shown on the parcel where they are located.

It is possible to have up to three distinct customers on a parcel of residential land: population units from two classes and the residence landlord. No more than two classes of population may live on a single residential parcel. All population units purchase personal goods as part of their annual expenditures. All Pl's of a class on a parcel purchase their personal goods at a single PG establishment. Landlords purchase personal goods only if they make maintenance expenditures. Buyers are assigned to specific commercial activities taking into account the price charged, transportation costs to the store, the capacity of the store, and boycotts.

The four letter codes used within a parcel on the map are: L = low income, M = middle income, H = high income, and R = residence. One or two of the first three codes prints if population units live on the parcel. If no one occupies the housing, no income class code is printed. The number after the letter code is the PG establishment code. The outside Local system PG suppliers are identified sequentially as determined by their location. Establishments located on parcels as one reads the map from top to bottom and from left to right have the lowest code numbers. The identification number assigned to a particular PG establishment might change from round to round if new PG's are being constructed at locations that are scanned prior to the parcel on which that particular PG is located.

The buyer code "R" will print on every parcel that has a residence. If the landlord makes maintenance expenditures then the R is followed by a PG establishment code. No code after the R indicates that no maintenance is being performed on that residence parcel.

Figure 10.1


TWOCITY
PERSONAL GOODS ALLOCATION MAP
ROUND 2
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
PARCELS
TOP ROW: PI CLASS AND SERVING PG
MIDDLE ROW: PI CLASS AND SERVING PG
BOTTOM ROW: RESIDENCE AND SERVING PG
ASTERISKS IDENTIFY LOCATION OF PG
NN IS THE CODE NUMBER

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6. Personal Services Allocation Map

This map identifies the location of Personal Services establishments and PS establishment that serves the customers from each parcel of land that has residences on it. PS establishments are located on those parcels that are encircled by asterisks. Their code number is also shown on the parcel where they are located.

It is possible to have up to three distinct customers on a parcel of residential land: population units from two classes and the residence landlord. No more than two classes of population may live on a single residential parcel. All population units purchase personal services as part of their annual expenditures. All P1's of a class on a parcel purchase their personal services at a single PS establishment. Landlords purchase personal services only if they make maintenance expenditures. Buyers are assigned to specific commercial activities taking into account price charged, transportation costs to the store, capacity of the store, and boycotts.

The four letter codes used within a parcel on the map are L = low income, M = middle income, H = high income, and R = residence. One or two of the first three codes prints if population units live on the parcel. If no one occupies the housing, no income class code is printed. The number after the letter code is the PS establishment code. The outside system suppliers are identified by the number code "1". Local system PS suppliers are identified sequentially as determined by their location. Establishments located on parcels as one reads the map from top to bottom and from left to right have the lowest code numbers. The identification number assigned to a particular PS establishment might change from round to round if new PS's are being constructed at locations that are scanned prior to the parcel on which that particular PS is located.

The buyer code "R" will print on every parcel that has a residence. If the landlord makes maintenance expenditures then the R is followed by a PS establishment code. No code after the R indicates that no maintenance is being performed on that residence parcel.

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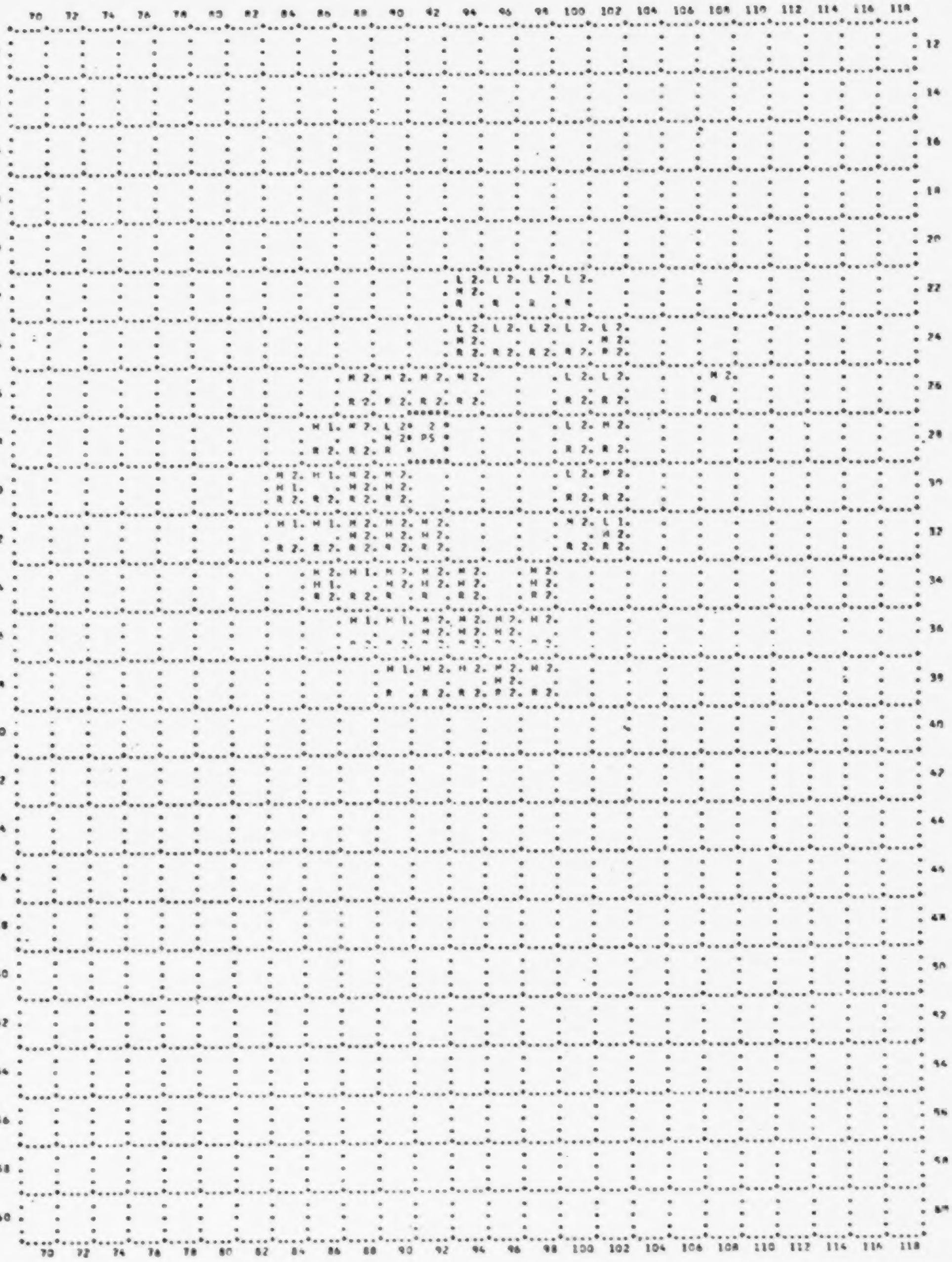
Figure 10.2

TWOCITY

PERSONAL SERVICES ALLOCATION MAP

ROUND 2


70
72
74
76
78
80
82
84
86
88
90
92
94
96
98
100
102
104
106
108
110
112
114
116
118
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
PS

PARCELS

TOP ROW: PI CLASS AND SERVING PS
MIDDLE ROW: PI CLASS AND SERVING PS
BOTTOM ROW: RESIDENCE AND SERVING PS

```
******  ASTERISKS IDENTIFY
* NN *  LOCATION OF PS
* PS *
*    *  NN IS THE
******  CODE NUMBER
```

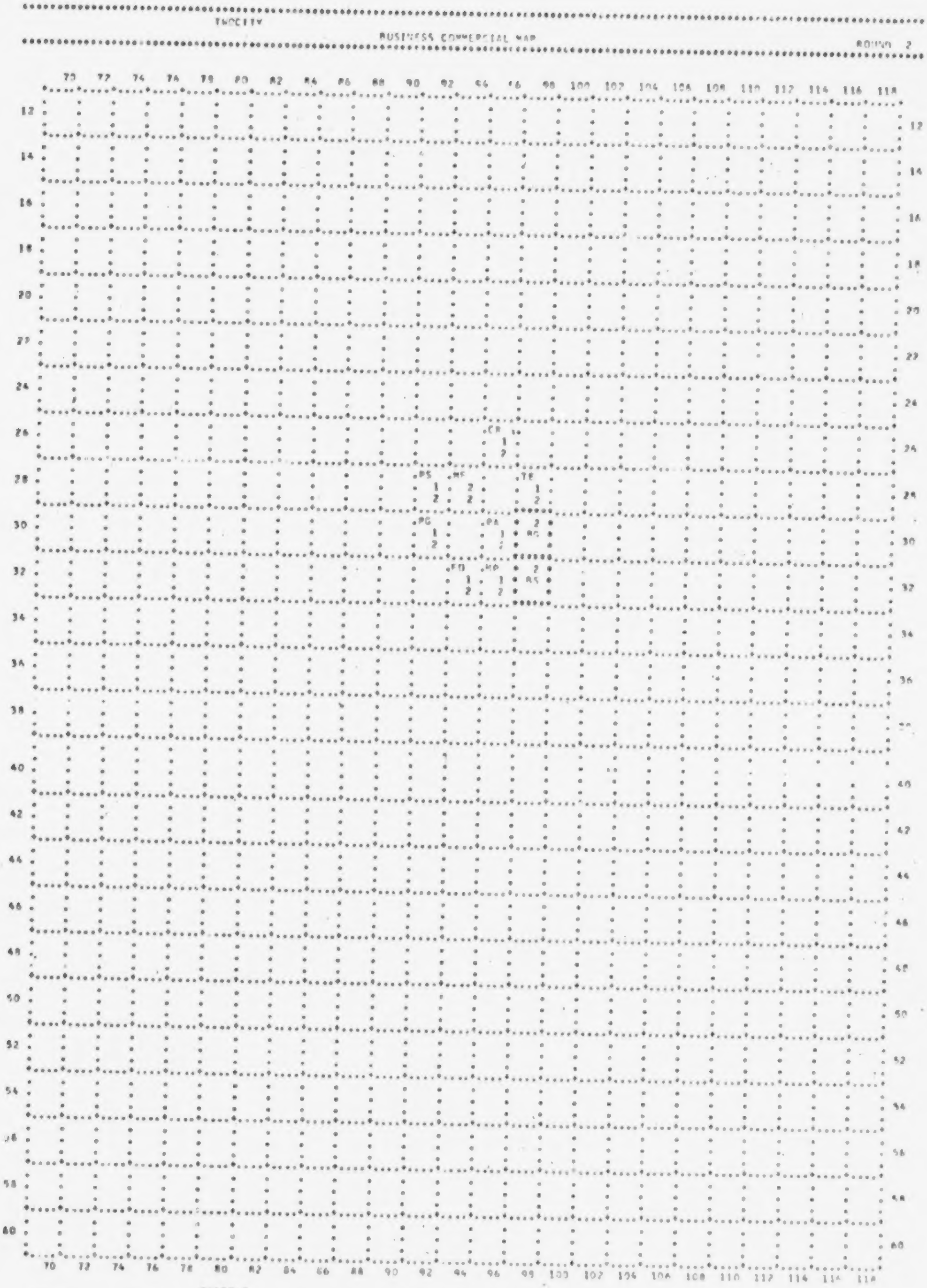
7. Business Commercial Map

This map identifies the location of BG and BS establishments and indicates the establishment code number for BG and BS establishments serving economic activities.

BG and BS establishments are located on those parcels that are encircled by asterisks and their identification number is shown. The outside system suppliers are always assigned the establishment code of "1". Local suppliers are then assigned numbers by starting at the top of the board and reading from left to right.

Local economic activities (industries and PG and PS commercial establishments) purchase BG and BS as part of their annual operation requirements. Buyers are assigned to a single specific supplier taking into account prices charged, transportation costs to the commercial establishments, capacity of the establishments, and boycotts.

The parcels on which buyers of BG and BS are located show the two letter code for the business activity and the number code of the BG establishment serving it (second line) and the number code of the BS establishment serving it (third line).


TWOCITY
BUSINESS COMMERCIAL MAP
ROUND 2
CR
PS
MF
TE
PG
PA
BG
FD
MP
BS
PARCELS

TOP ROW: LAND USE
MIDDLE ROW: BG SERVING PARCEL
BOTTOM ROW: BS SERVING PARCEL

```
******  ASTERISKS IDENTIFY
* NN *  LOCATION OF BG OR BS
* BX *
*    *  NN IS THE
******  CODE NUMBER
```

8. Municipal Treatment Plant Map

A Utility Department supplies water to all economic activities except some basic industries which obtain their own water from the surface water. Each utility district is also a water district. A parcel is supplied with municipal water and sewer service when utilities are installed on the parcel. The department can decide where to intake water, where to dump sewage, how much intake water it will provide, how much sewage treatment it will provide, and where treatment facilities will be located.

Municipal water intake and sewage treatment plants are located in the utility districts which they serve. An intake treatment plant processes the surface water removed from the parcel on which its intake point is located (not necessarily within the water district which it serves). All water treated by an intake treatment plant is processed to drinking water quality. The quality of the water before it is treated varies with the amount of pollution in the surface water where the intake point is located. There are nine water quality ratings, 1 being the best quality and 9 being the worst. A parcel's water quality rating is based on the volume of water on the parcel and the amount of pollution entering it from adjoining parcels.

Water Quality Rating	Description
1	Drinkable - best quality water
2	Drinkable - with minor treatment
3	Swimmable - direct body contact possible
4	Boating and Fishing - indirect body contact
5	Fair esthetic value
6	Poor esthetic value - treatable at moderate cost
7	No esthetic value - treatable at high cost
8	Negative esthetic value - treatable at very high cost
9	Unusable water

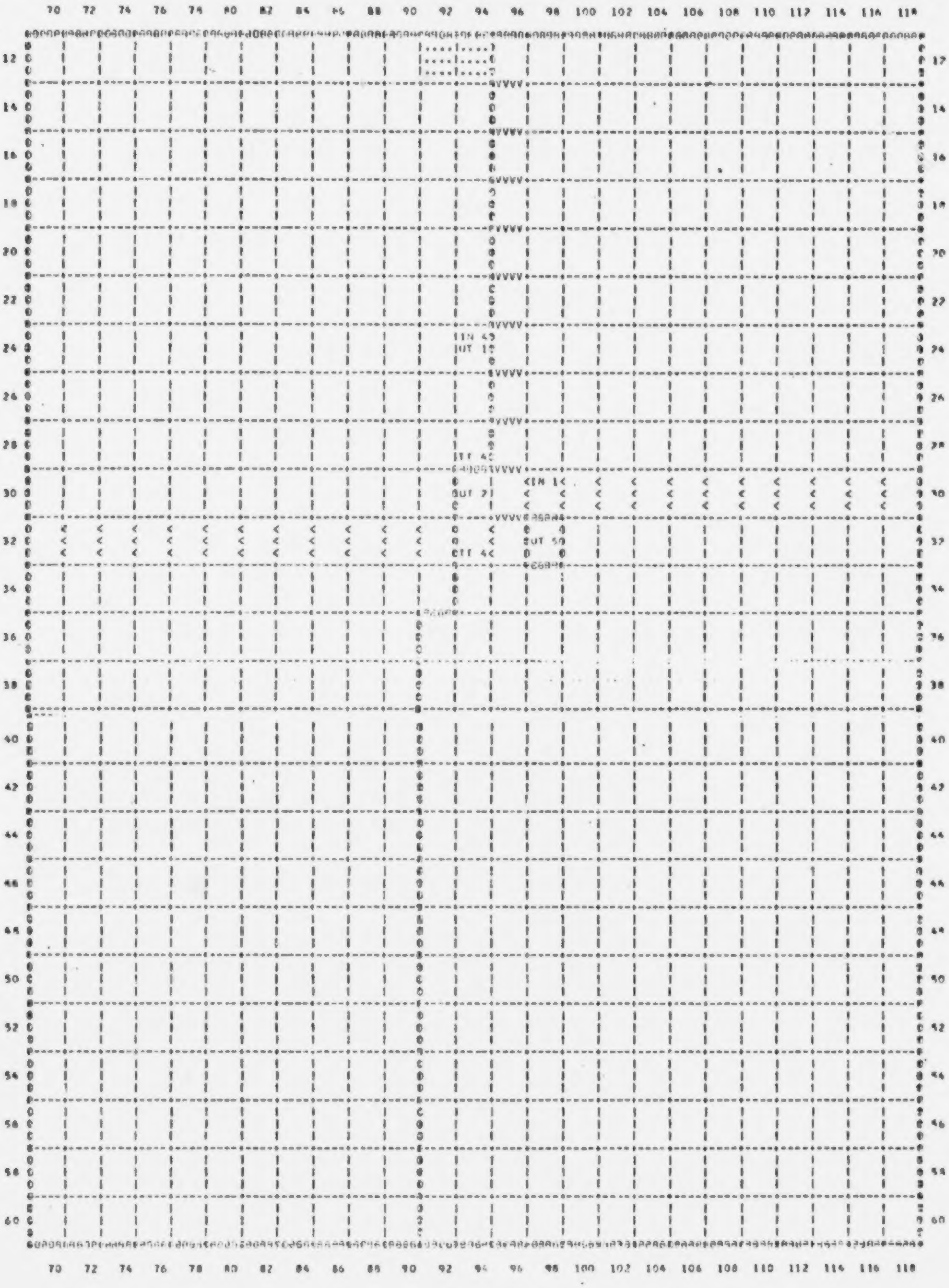
Seven types of pollutants are measured for the quality rating.

Pollutants	Description
BOD	Biochemical Oxygen Demand; the

Figure 10.9

TWOCITY
MUNICIPAL TREATMENT PLANTS

ROUND 2



70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
IN 43
OUT 1
OUT 21
IN 1
OUT 50

PARCELS

TOP LEFT: IN FOR MUNICIPAL INTAKE
TREATMENT PLANT
TOP RIGHT: LEVEL OF INTAKE TREATMENT PLANT
MIDDLE LEFT: UT FOR UTILITY DISTRICT PLANT
MIDDLE RIGHT: CODE NUMBER OF UTILITY DISTRICT
BOTTOM ROW: MUNICIPAL EFFLUENT TREATMENT TYPE AND LEVEL

....
.... LAKE PARCELS
....

PARCEL EDGES

>AV< DIRECTION OF FLOW

---- NO WATER FLOWING
BETWEEN PARCELS

OOOO UTILITY DISTRICT BOUNDARY

Pollutants	Description
	natural breakdown of this pollutant causes a decrease in the concentration of dissolved oxygen in the water.
Chlorides	Chlorides are employed as an indicator of persistent pollutants.
Nutrients	Phosphate, nitrite, nitrate, nitrogen, and phosphorous.
Coliform Bacteria	Indication of the potential health hazard of a given body of water.
Temperature	A measure of the deviation from the normal temperature of the surface water.
Oil and Floating Solids	Any oil added to the system and all floating solids such as refuse, garbage, cans, boards, tires, etc.
High-Level Wastes	Highly toxic, non-degradable substances.

The quality of water at a district's intake point affects, among other things, the cost to process the water to drinking water quality. The water quality of a parcel is shown on the Water Quality Map. That quality is not affected by any pollution dumped on the parcel, only by pollution dumped on upstream parcels.

An inflow treatment plant, while able to make all but the worst (quality 9) water drinkable, has a capacity which is a function of its level. The amount of water which a district needs is a function of the needs of the activities located in the district, but the amount of water which a district can obtain may be limited by its inflow treatment plant capacity. Whenever a district cannot obtain all of its needed water for any reason, including insufficient inflow treatment plant capacity, the activities served by the district purchase that proportion of their water needs which cannot be met locally from the Outside at a high cost. The cost to construct an inflow treatment plant increases with the number of levels constructed. Unlike levels of other activities in the model, municipal treatment plant costs and capacities are not necessarily even multiples of level one costs and capacities. The land requirements, however, are multiples of level one.

Municipal sewage treatment plants can be constructed not only to different levels (capacities) but also to different types of treatment. The types of sewage treatment are, in increasing order of pollution removal:

Chlorination (CL)
Primary Treatment (PT)
Secondary Treatment (ST)
Tertiary Treatment (TT)

Tertiary treatment requires the three other types of treatment; secondary treatment requires chlorination and primary treatment. The level of treatment printed on the map is the level of the type printed and of all lesser types. There is no provision for the case of different levels of different types of treatment within a single district.

Since treatment plants have fixed capacities which vary by their levels, any district's sewage in excess of its plant's capacity flows untreated into the surface water on the parcel on which the district's outflow point is located.

Note that all of a district's intake treatment must be located on a single parcel. Likewise, all of its sewage treatment must be on a single parcel, although that parcel does not have to be the same one as that on which its intake treatment plant is located.

'UT' appears in the middle row of a parcel if there is a utility plant on the parcel. Next to the 'UT' is the code number of the utility plant. That number matches the number printed next to the district's intake and outflow points on the Municipal Inflow and Outflow Point Map.

9. Water Quality Map

The surface water quality on a parcel is a function of the pollution entering the parcel from adjoining parcels and of the amount of water on the parcel itself. The water quality on a parcel is not affected by any dumping activity on the parcel itself. Any activity which removes water from a parcel removes it at the quality shown on the Water Quality Map.

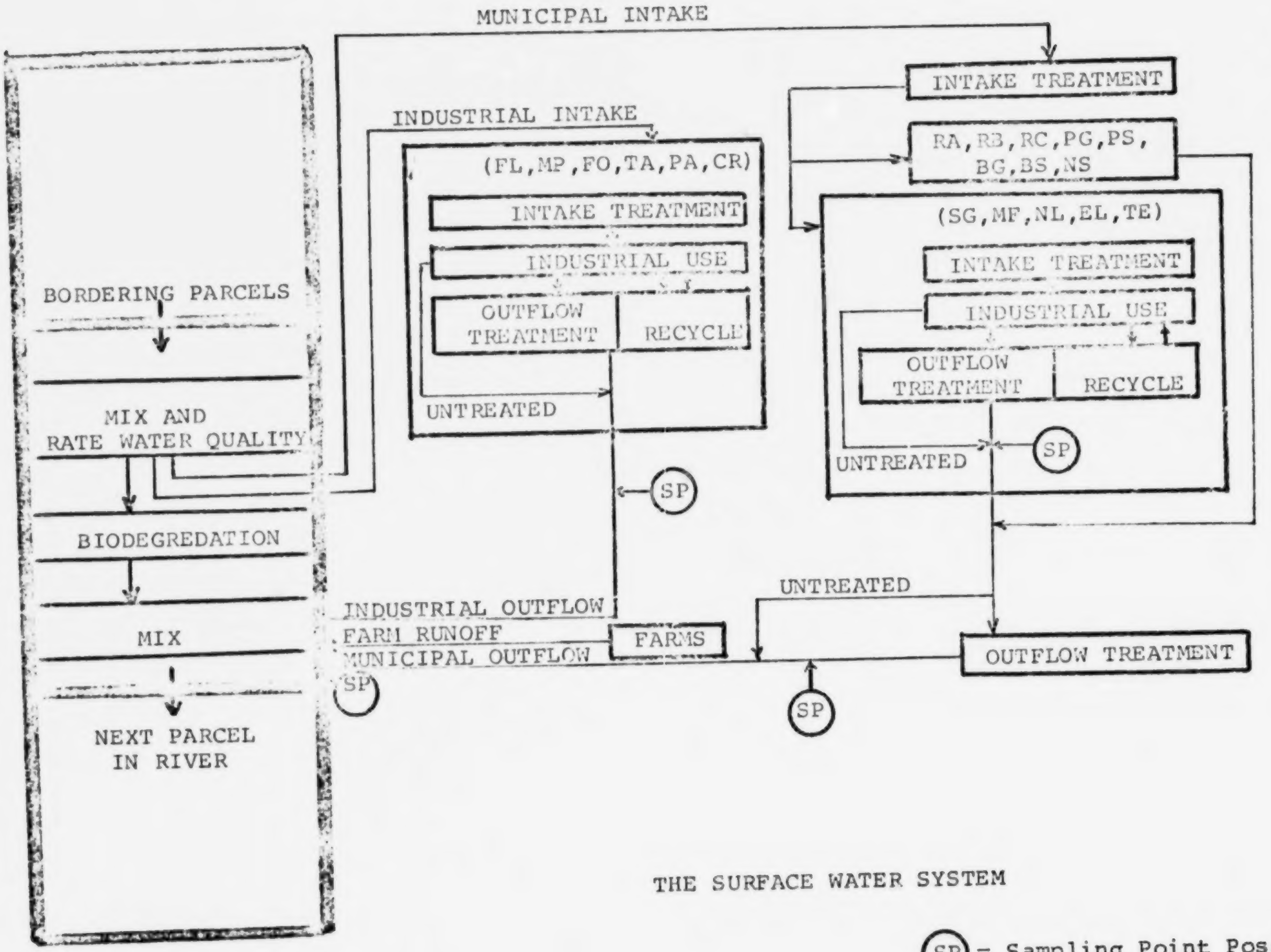
Quality is the only characteristic of surface water which can change during a run of the model. The other characteristics (rate of flow, volume, and surface area) are constant.

Water Sampling Stations can be set up to measure the exact pollution content of the water flowing out of parcels. Sampling stations can also be established to measure the pollution content of water generated by either individual economic activities or municipal systems. The operation of a sampling station is charged to the Utility Department of the jurisdiction in which the station is located.

The figure on the next page illustrates the processes which affect surface water pollution. The pollution flowing into a parcel from adjoining parcels is mixed in the water on the parcel. The pollution concentration per MGD is then measured and the water is rated in one of the nine water quality categories. The water quality rating is the worst rating category generated in any single pollutant. The rating allows no trade-off between a pollutant which is present in very low concentration and one which is very highly concentrated.

Next, water is removed if there are any intaking activities on the parcel. There are two types of intaking activities: 1) basic industries of the types which require surface water; and 2) municipal intake points. There can be only one economic activity on a parcel, and if it is a surface water user, it intakes and dumps on the parcel on which it is located. Municipal intake water is sent to the municipal intake treatment plant and from there to activities served by the district.

The surface water which is not removed undergoes a biological change process in which some of the pollutants decay naturally. That water is mixed with any water dumped on the parcel. There are three types of activities which can dump on a parcel. In addition to basic industries

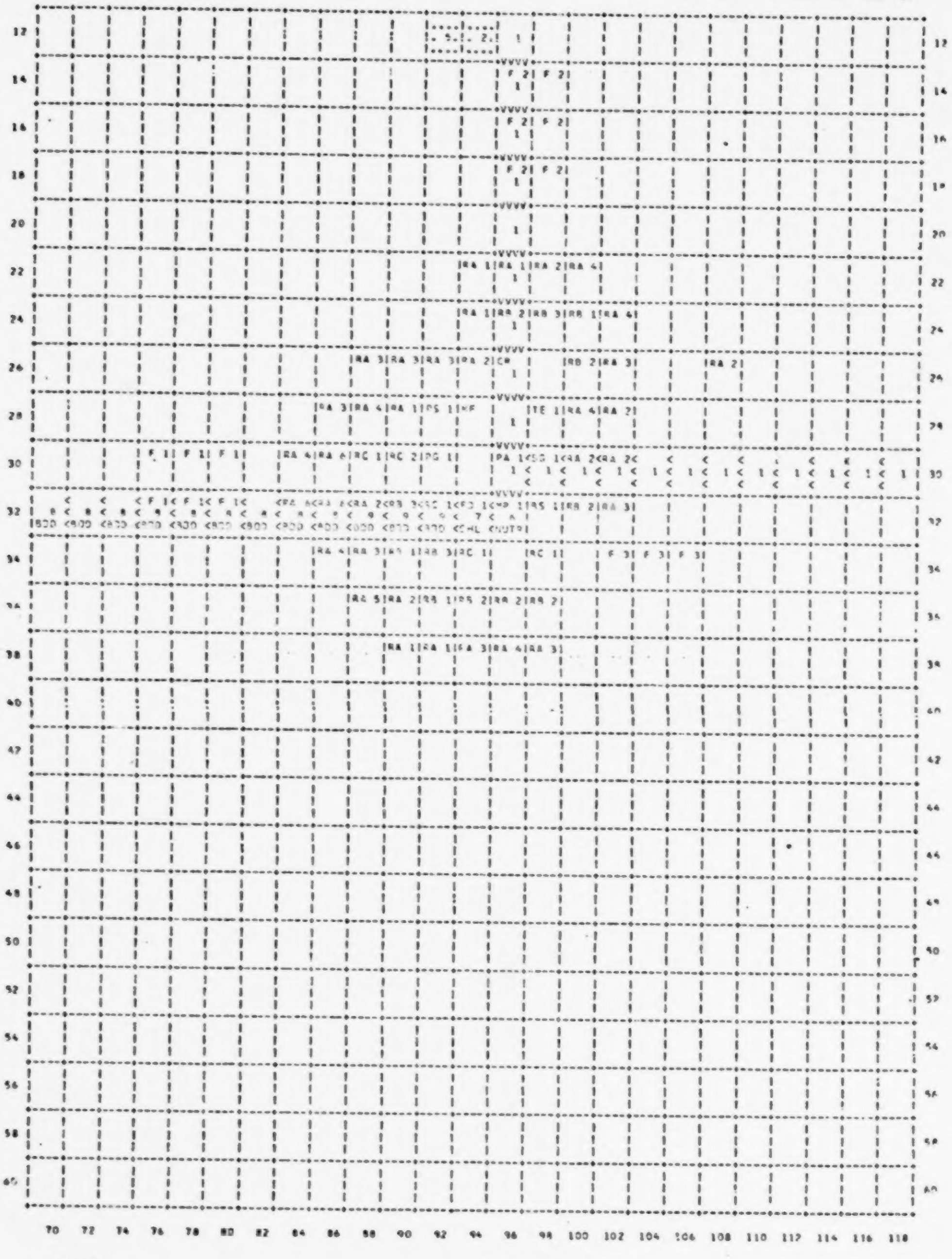

MUNICIPAL INTAKE
INTAKE TREATMENT
INDUSTRIAL INTAKE
RA,RB,RC,PG,PS,
BG,BS,NS
(FL,MP,FO,TA,PA,CR)
INTAKE TREATMENT
INDUSTRIAL USE
OUTFLOW TREATMENT
RECYCLE
UNTREATED
(SG,MF,NL,EL,TE)
INTAKE TREATMENT
INDUSTRIAL USE
OUTFLOW TREATMENT
RECYCLE
UNTREATED
SP
SP
BORDERING PARCELS
MIX AND RATE WATER QUALITY
BIODEGREDATION
MIX
NEXT PARCEL IN RIVER
UNTREATED
INDUSTRIAL OUTFLOW
FARM RUNOFF
FARMS
MUNICIPAL OUTFLOW
OUTFLOW TREATMENT
SP
SP

THE SURFACE WATER SYSTEM

(SP) = Sampling Point Possible

Figure 10.8

```
TWOCITY
WATER QUALITY MAP
                                                                ROUND 3
```



```
PARCELS
-------
   TOP ROW: ECONOMIC ACTIVITY TYPE
            AND OPERATING LEVEL
            FARM TYPE IF FARM ON PARCEL
MIDDLE ROW: SURFACE WATER QUALITY RATING
BOTTOM ROW: WORST POLLUTANT

....
....  LAKE PARCELS
....
```

```
PARCEL EDGES
------------
>AV<  DIRECTION OF FLOW

----  NO WATER FLOWING
      BETWEEN PARCELS
```

and municipal outflow points, farm runoff can add to the pollution on a parcel. Whereas basic industries and municipalities can treat their effluent and thus remove some or all of their pollution, farm pollution can be cut back only if the farm owner decreases the amount of fertilizer used on the farm. The total amount of pollution is then moved on to the next parcel in the river.

The water quality map shows where rivers and economic activities are located in addition to water quality.

10. Water Usage Map

Basic industries can treat their effluent in order to remove pollutants. An industry's effluent treatment plant is located on the same parcel as the industry and does not consume land. Like municipal effluent treatment plants, industrial treatment plants can be of four types: chlorination (CL), primary treatment (PT), secondary treatment (ST), and tertiary treatment (TT). Industrial treatment plants can be constructed to any level and each treatment plant level has the capacity to treat all of the effluent of a level of the industry type which it is constructed to serve. The construction cost of a level of treatment plant varies by treatment type and type of industry.

Industries can recycle up to half of their effluent. Recycled water is not processed through an effluent treatment plant. Its treatment is a process distinct from industrial intake or outflow treatment and costs a fixed number of dollars per MG recycled. So, a level two industry at a recycle level of 100% and having a level one effluent treatment plant treats all of the water which it dumps. If the recycle level under those conditions were 50%, then the industry would treat only two-thirds of the amount which it dumped and one third would be dumped untreated.

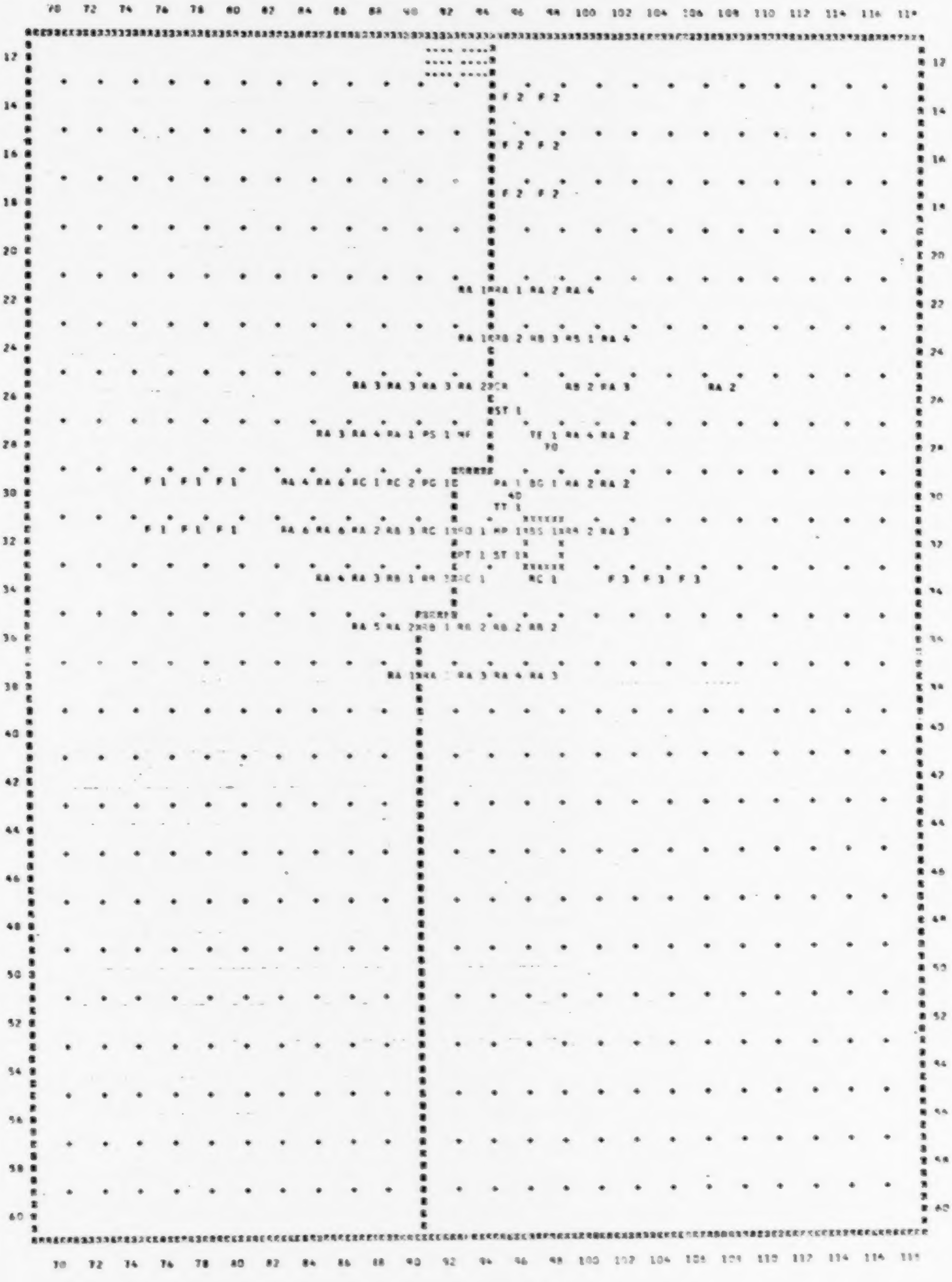
Unlike municipal water intake treatment facilities, industrial intake treatment is assumed to exist when the industry is constructed and it is assumed to have the capacity to treat all of the water required by the industry. Like municipal intake treatment costs, industrial intake treatment costs increase as water quality worsens, and the worst water (quality 9) cannot be treated. The industry is forced to pay a high cost for water, the cost represented by the Outside price of water. Furthermore, intake water quality affects the depreciation of surface water users, a reflection of wear on treatment equipment.

NOTE: Regardless of the amount of recycling, intake water quality has the same effect on industrial depreciation. The volume treated does not matter. The assumption is that recycled water goes through intake treatment, so no wear and tear on treatment equipment has been avoided.

Figure 10.7

TWOCITY
WATER USAGE MAP

ROUND 2


70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
F 2 F 2
F 2 F 2
F 2 F 2
RA 1 RA 1 RA 2 RA 4
RA 1 RB 2 RB 3 RS 1 RA 4
RA 3 RA 3 RA 3 RA 2 RB 2 RA 3 RA 2
ST 1
RA 3 RA 4 RA 1 PS 1 RF TF 1 RA 4 RA 2
70
F 1 F 1 F 1 RA 4 RA 6 RC 1 RC 2 PG 1 PA 1 BG 1 RA 2 RA 2
40
TT 1
F 1 F 1 F 1 RA 6 RA 6 RA 2 RB 3 RC 1 1 MP 1 1 2 RA 3
PT 1 ST 1
RA 6 RA 3 RB 1 RB 1 RC 1 F 3 F 3 F 3
RA 5 RA 2 1 RB 2 RB 2 RB 2
RA 1 RA 3 RA 4 RA 3

PARCELS

TOP ROW: ECONOMIC ACTIVITY TYPE
AND OPERATING LEVEL
MIDDLE ROW: (FOR BASIC INDUSTRIES)
PERCENT OF WATER RECYCLED
BOTTOM ROW: (FOR BASIC INDUSTRIES)
EFFLUENT TREATMENT
TYPE AND LEVEL

....
.... LAKE PARCELS
....

PARCEL EDGES

EE EE UTILITY DISTRICT BOUNDARY
DD DD JURISDICTION BOUNDARY
BB BB BOTH

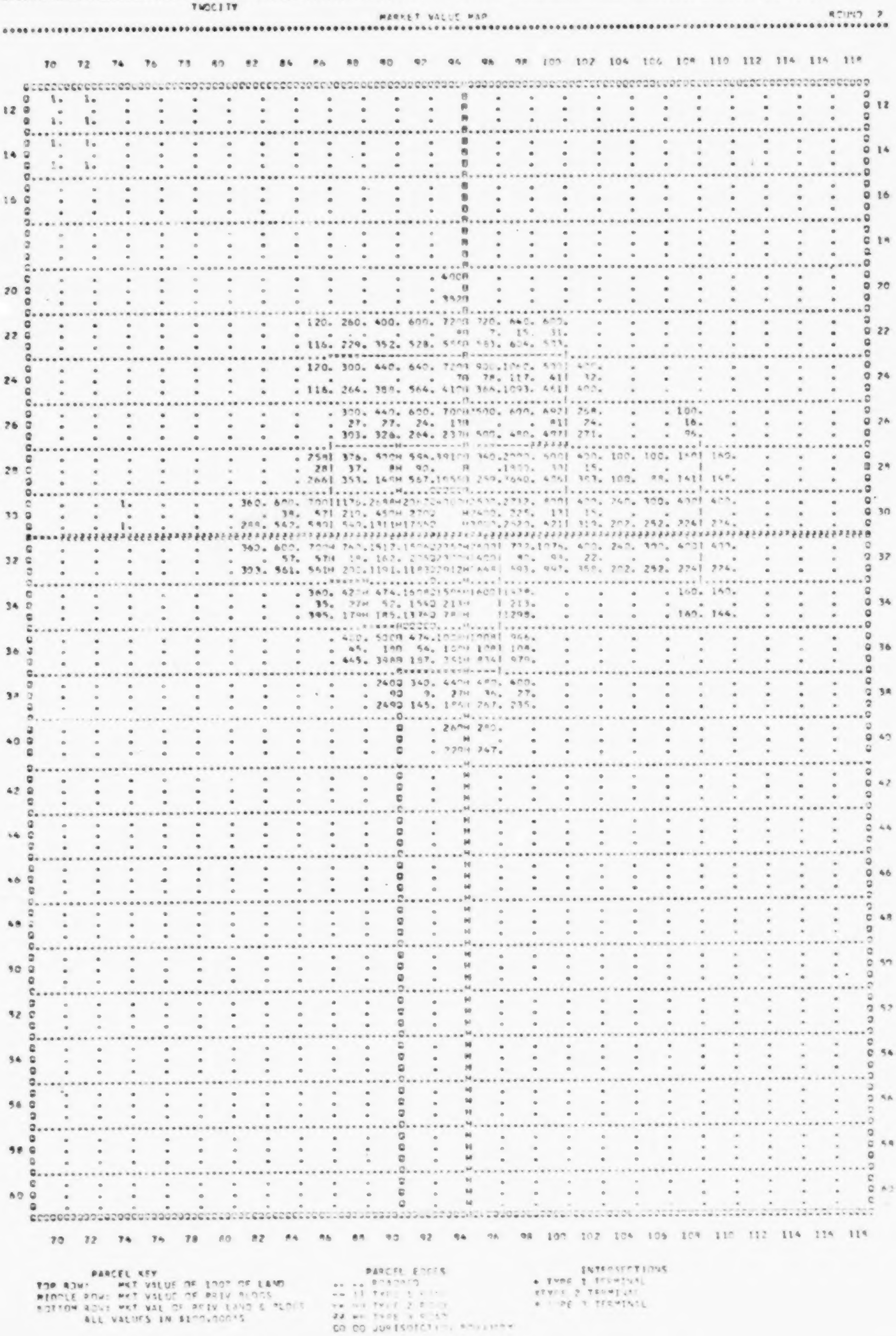
11. Market Value Map

This map designates the jurisdictional boundaries (000) and the highway system (including terminals). Nonfarm parcels of land that are owned by local decision-makers contain information on the market value of the land and developments on the parcel (values are in $100,000's).

The top row of each such parcel indicates the market value of 100% of the land on the parcel. This value of 100 percent of the land on the parcel is printed so that comparisons may be made from one parcel to another without having to take into consideration what percent of each parcel is privately owned. Since there is usually some land on most parcels that is not privately owned, the actual market values of the land will be somewhat less than indicated on the map. Nonprivate uses of the land might be for rights of way, schools, municipal services, utilities, treatment plants, parks, institutional, public undeveloped, water bodies, and topographically undevelopable.

The middle row indicates the market value of all private developments. This value is the normal new value (see Economic Master Table) of each land use times the constructed level times the value ratio.

Figure 10.16


TWOCITY
MARKET VALUE MAP
ROUND 2
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
PARCEL KEY
TOP ROW: MKT VALUE OF 100% OF LAND
MIDDLE ROW: MKT VALUE OF PRIV BLDGS
BOTTOM ROW: MKT VAL OF PRIV LAND & BLDGS
ALL VALUES IN $100,000'S
PARCEL EDGES
.. .. BOARDED
-- II TYPE 1 ROAD
** HH TYPE 2 ROAD
ZZ WW TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
$TYPE 2 TERMINAL
* TYPE 3 TERMINAL

12. Assessed Value Map

This map shows the assessed values of non-farm land and of developments on the land for those parcels of land that have a private local system owner (i.e., non-farm parcels owned by Economic Teams). The top number on a parcel square is the assessed value of 100% of the land.

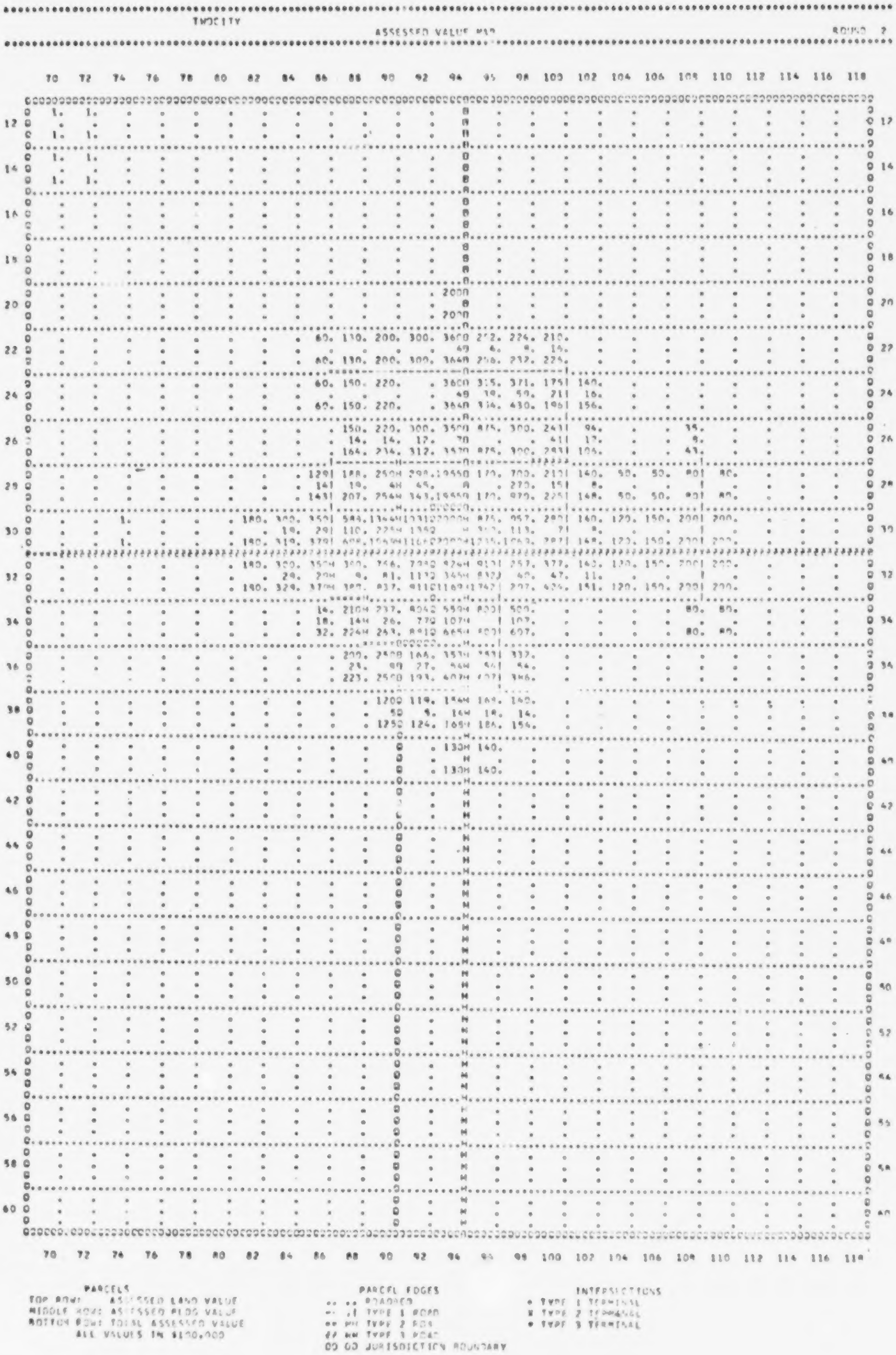
Assessed values of land are created in two ways: first, land that is newly purchased at a price higher than the previous market value is given a new market value equal to the sale price and a new assessed value that is dependent upon the jurisdiction's developed land assessment ratio or undeveloped land assessment ratio, depending on whether there is any economic activity on the parcel; second, through local assessment policy. The local assessment policy can change the value by altering the land assessment ratio (either jurisdiction-wide or by parcel) or inputting a dollar amount (this decision only lasts for one round).

The second number is the assessed value of the development on the parcel. If no number appears in this position, the land is still undeveloped. Assessed values of developments are changed through new constructions, declining market values of developments (resulting from declining value ratios), and changes in the development assessment ratios. The Assessment Department may change the assessed values of developments by changing the jurisdiction-wide development assessment ratios, changing the development assessment ratio for specific parcels, or by inputting a dollar value of the development assessment (this decision lasts for only one round and must be input each round for which the dollar assessed value is to remain the same).

The last line on a privately-owned land parcel shows the total (land and development) assessed value. The dollar values on this map are expressed in a scale factor ($1m; $100,000; or $10,000) that is chosen by the computer based upon the highest and lowest dollar values represented on the map. Therefore, the map key is adjusted automatically when the need arises.

This map also shows jurisdictional boundaries, the road netowrk, and the location of terminals.

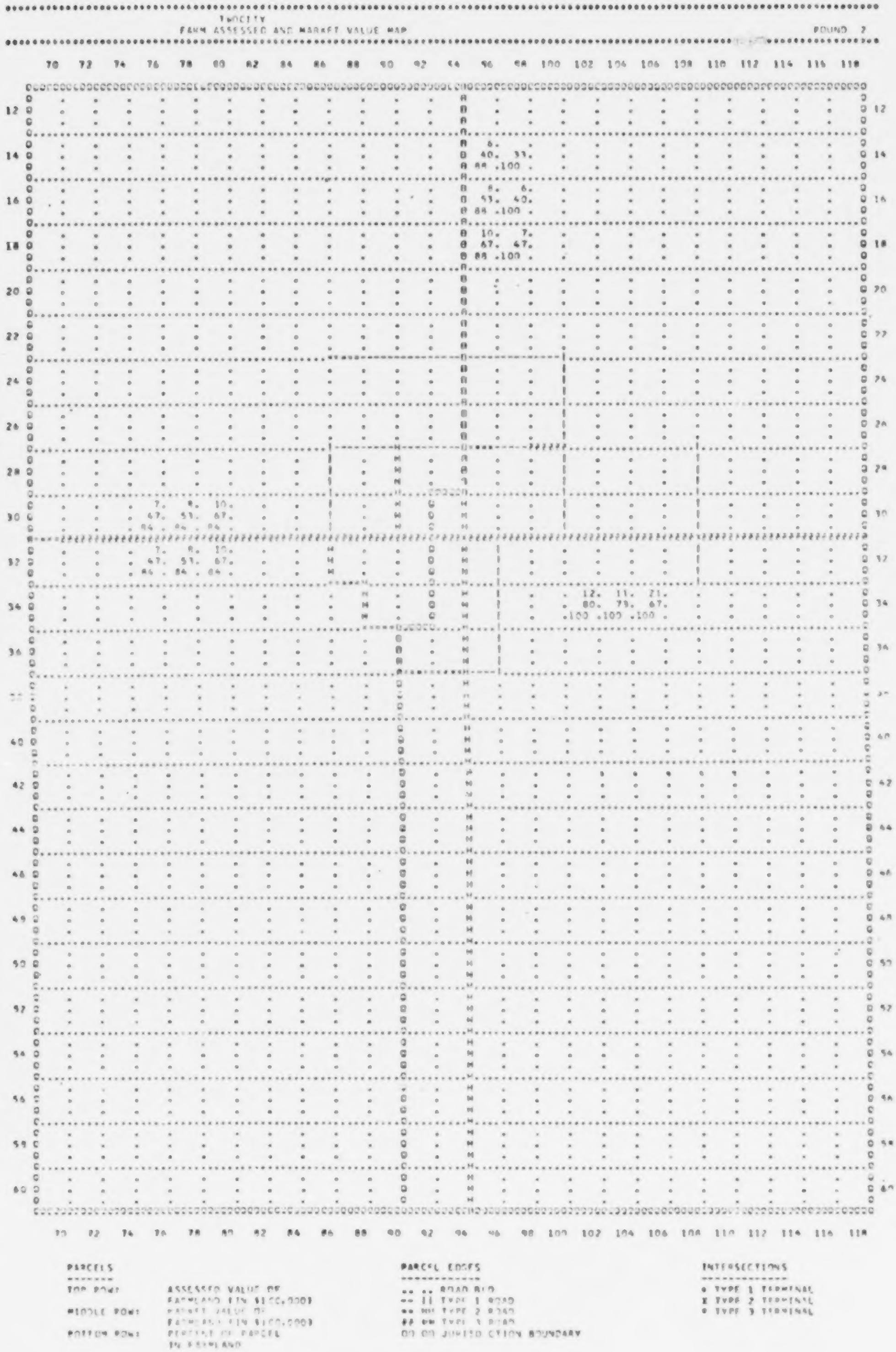
Figure 10.17


TWOCITY
ASSESSED VALUE MAP
ROUND 2
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
PARCELS
TOP ROW: ASSESSED LAND VALUE
MIDDLE ROW: ASSESSED BLDG VALUE
BOTTOM ROW: TOTAL ASSESSED VALUE
ALL VALUES IN $100,000
PARCEL EDGES
.. .. BOARDED
-- :I TYPE 1 ROAD
== HH TYPE 2 ROAD
## WW TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
• TYPE 1 TERMINAL
X TYPE 2 TERMINAL
• TYPE 3 TERMINAL

13. Farm Assessed and Market Value Map

The value shown for a farm parcel on the map is for that portion of a parcel which is in farm use. The ratio of assessed value to market value is set by the Assessor of the jurisdiction in which a farm is located. A farm owner pays local property taxes at the rate set by the Chairman and on the base set by the Assessor of the jurisdiction in which the farm is located. Since a farm's net income before taxes is fixed according to the farm's fertilizer level, the amount of land at the farm and the farm type, the only variable expenditure is local property tax.

Figure 10.15


TWOCITY
FARM ASSESSED AND MARKET VALUE MAP
ROUND 2
PARCELS
TOP ROW: ASSESSED VALUE OF FARMLAND (IN $100,000)
MIDDLE ROW: MARKET VALUE OF FARMLAND (IN $100,000)
BOTTOM ROW: PERCENT OF PARCEL IN FARMLAND
PARCEL EDGES
.. .. ROAD BID
-- II TYPE 1 ROAD
** HH TYPE 2 ROAD
## TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
● TYPE 1 TERMINAL
X TYPE 2 TERMINAL
● TYPE 3 TERMINAL

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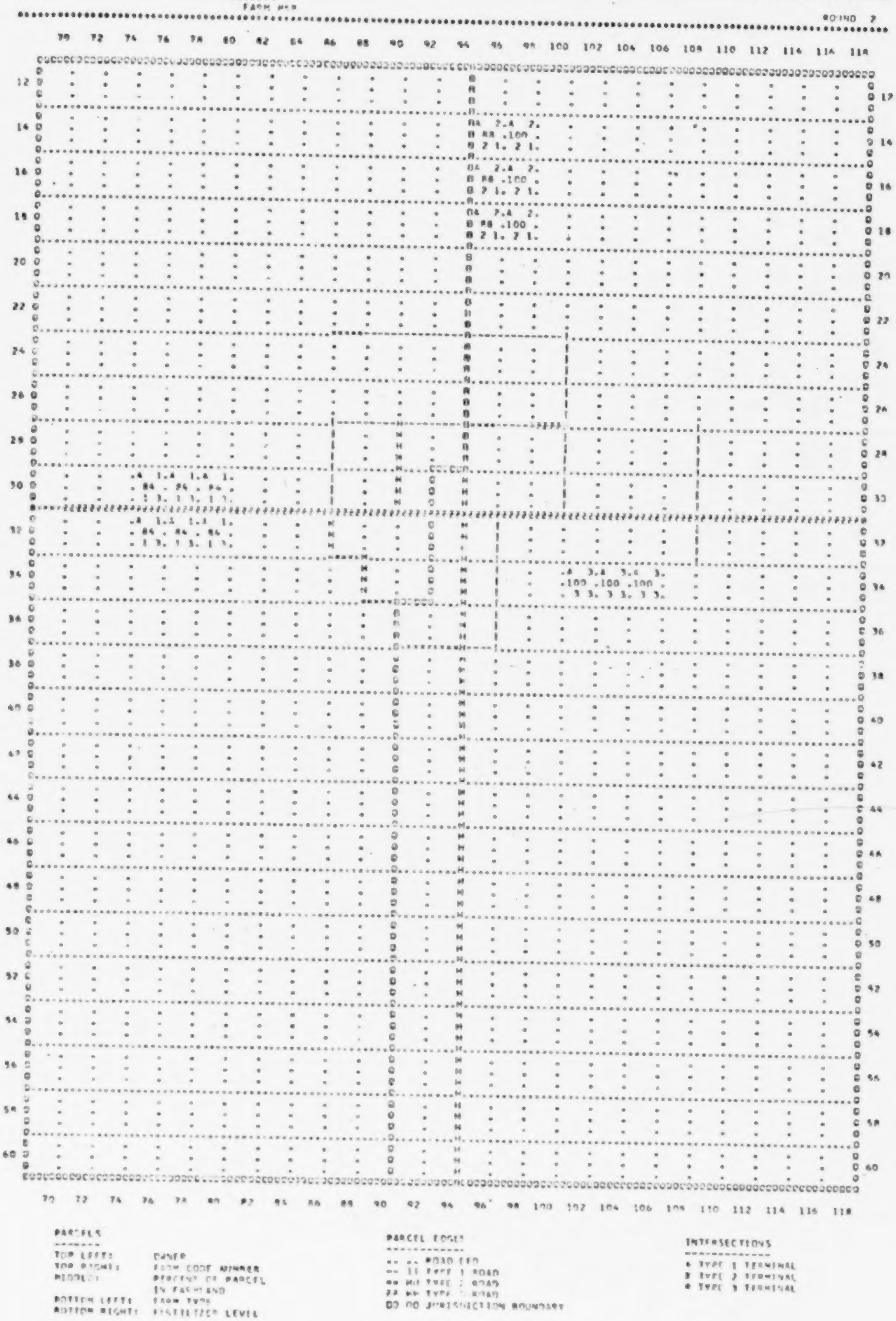
14. Farm Map

A farm can contain more than one parcel. All of the parcels in a single farm have the same owner, farm code number, farm type, and fertilizer level. The amount of land in farm use may be different for the different parcels in a single farm. The rest of the land can be in public use or can be topographically unusable. No other economic activity can be located on a farm parcel, and all of the farmland on a single farm parcel is of the same farm type. When the economic owner of a farm parcel changes, the parcel ceases to be classified as a farm. Once an initial starting configuration of the board has been selected, no farms can be created.

There are two types of decisions which a farm owner can make: set the fertilizer level for a farm; and sell part or all of the farmland on a farm.

A farm's fertilizer level is an integer from 0 to 3. Associated with each of the four fertilizer factors is a multiplierwhich represents the increase in normal income which occurs at that fertilizer factor for the farm type. There is also an associated amount of pollution in the runoff resulting from each fertilizer factor. Volume of runoff stays the same for a farm parcel regardless of the amount of land on that parcel in farm activity. When a parcel is no longer a farm, no more runoff exists. A farm owner's income increases as he sets a higher fertilizer factor level. Likewise, the amount of pollution on a farm's runoff increases with the fertilizer level.

Figure 10.14


TWOCITY
FARM MAP
ROUND 2
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
PARCELS
TOP LEFT: OWNER
TOP RIGHT: FARM CODE NUMBER
MIDDLE: PERCENT OF PARCEL IN FARMLAND
BOTTOM LEFT: FARM TYPE
BOTTOM RIGHT: FERTILIZER LEVEL
PARCEL EDGES
.. .. ROAD END
-- II TYPE 1 ROAD
== HH TYPE 2 ROAD
ZZ WW TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
TYPE 1 TERMINAL
TYPE 2 TERMINAL
TYPE 3 TERMINAL

15. Farm Runoff Map

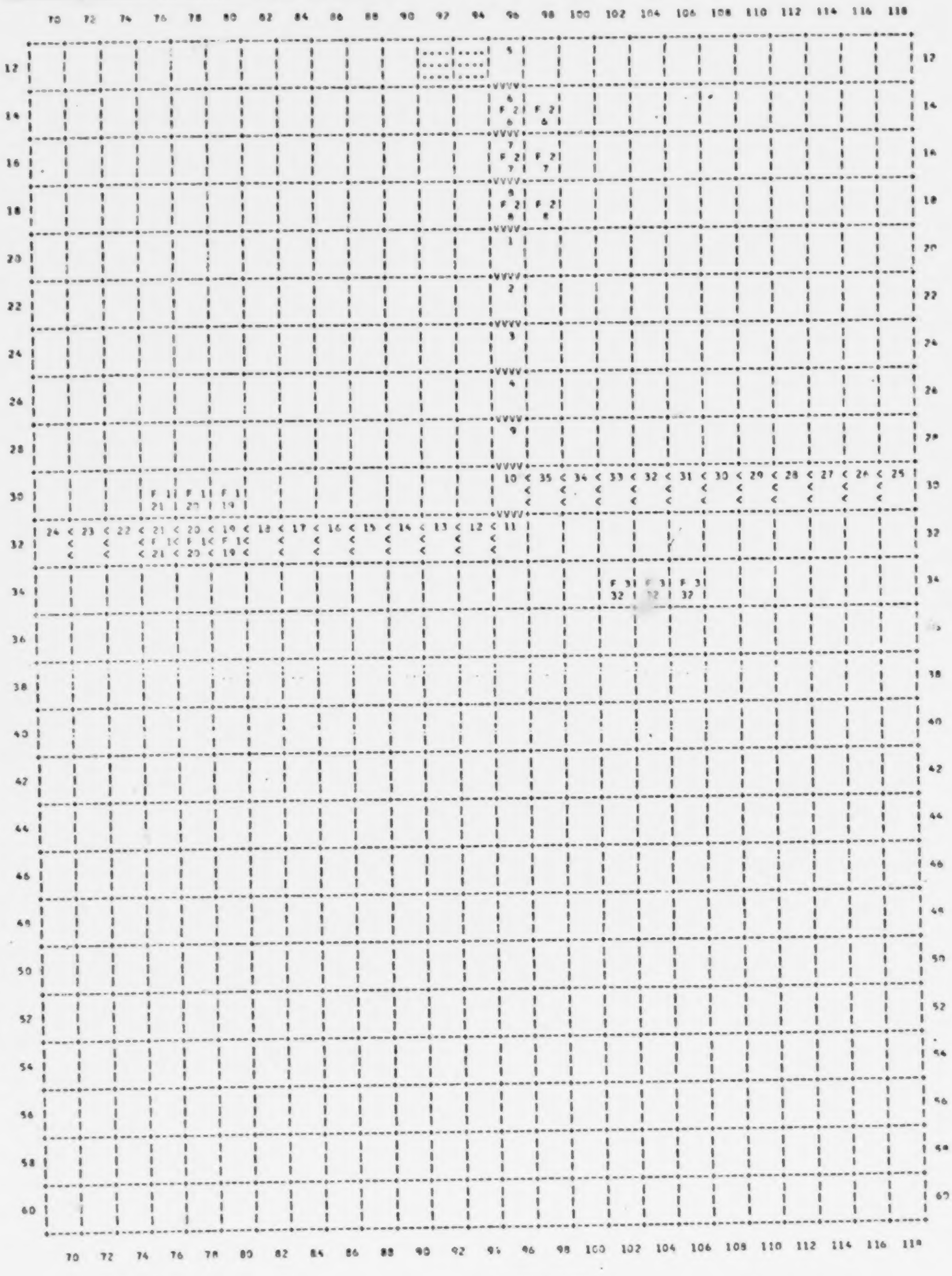
Farms do not use surface water or municipally-supplied water. Their water requirements are assumed to be met by rain or ground water. However, some of the water which falls on farms runs into the surface water. Farms use fertilizer, and those nutrients flow into the surface water in farm runoff. The Farm Runoff Map shows where farm runoff flows. The program assigns each surface water parcel a code number, which is printed on the top row of parcels containing surface water. Wherever there is a farm, the middle row shows 'F' and the farm type. Different types of farms have different basic fertilizer requirements and net incomes from sales. On a farm parcel the bottom row of the parcel shows the code number of the surface water parcel on which the farm parcel's runoff flows.

A farm owner sets a level of fertilizer use for the farm. The higher the fertilizer level, the greater the concentration of nutrients in the runoff from the parcels comprising the farm.

Figure 10.12

TWOCITY
FARM RUNOFF MAP

ROUND 2


70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60

PARCELS

TOP ROW: (FOR SURFACE WATER PARCELS)
CODE NUMBER OF PARCEL
MIDDLE ROW: FARM TYPE
BOTTOM ROW: PARCEL WHERE RUNOFF FLOWS

....
.... LAKE PARCELS
....

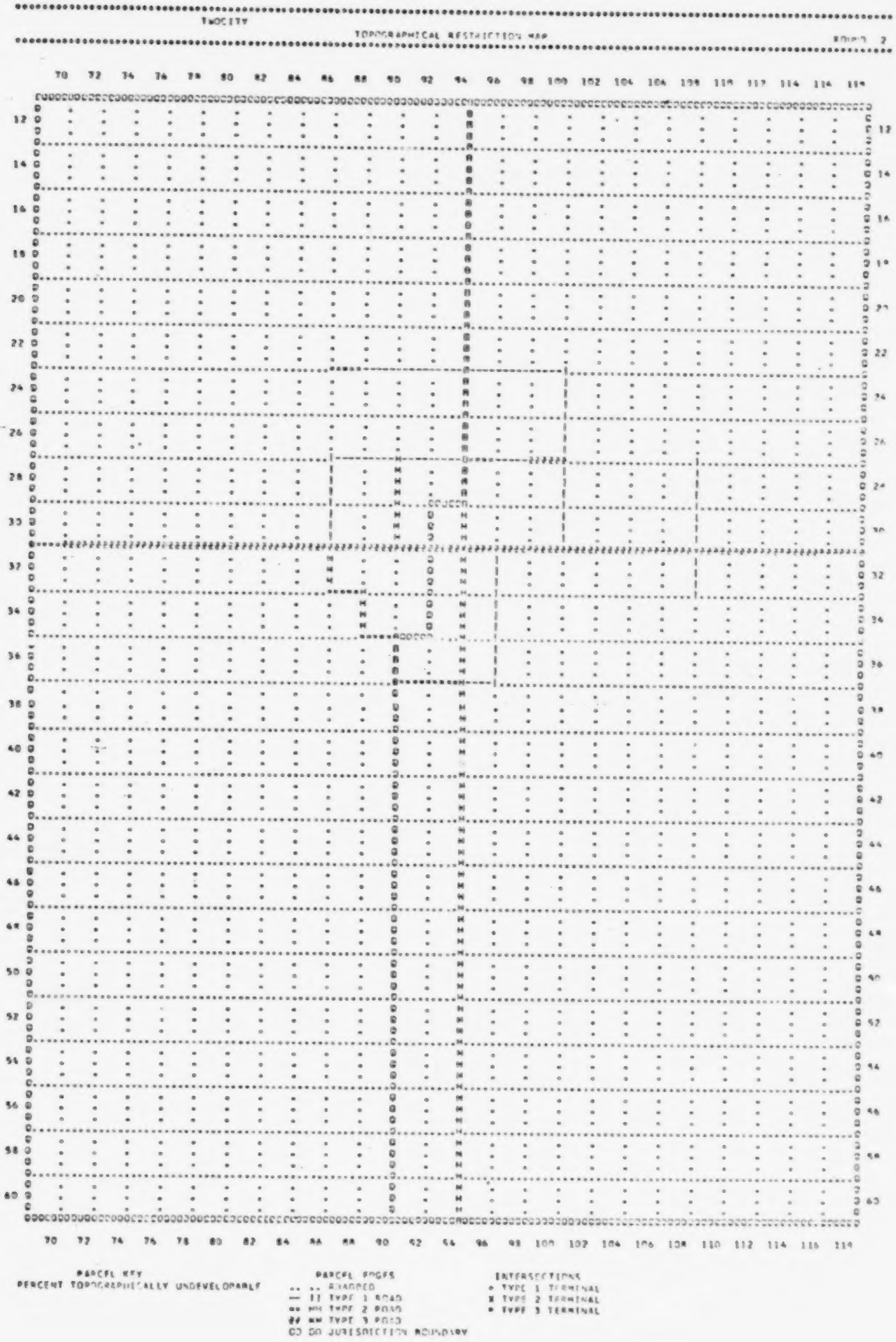
PARCEL EDGES

>AV< DIRECTION OF FLOW
---- NO WATER FLOWING
BETWEEN PARCELS

16. Topographical Restriction Map

This map shows the percent of a parcel that may not be purchased or developed by any local decision-makers. Land that is topographically undevelopable includes mountains, rock outcrops, swamps. None of the area consumed by water bodies represented in the local system (large lakes, small lakes, and rivers) is shown on this map. The map also shows jurisdictional boundaries, the road network, and the location of terminals.

Figure 10.25

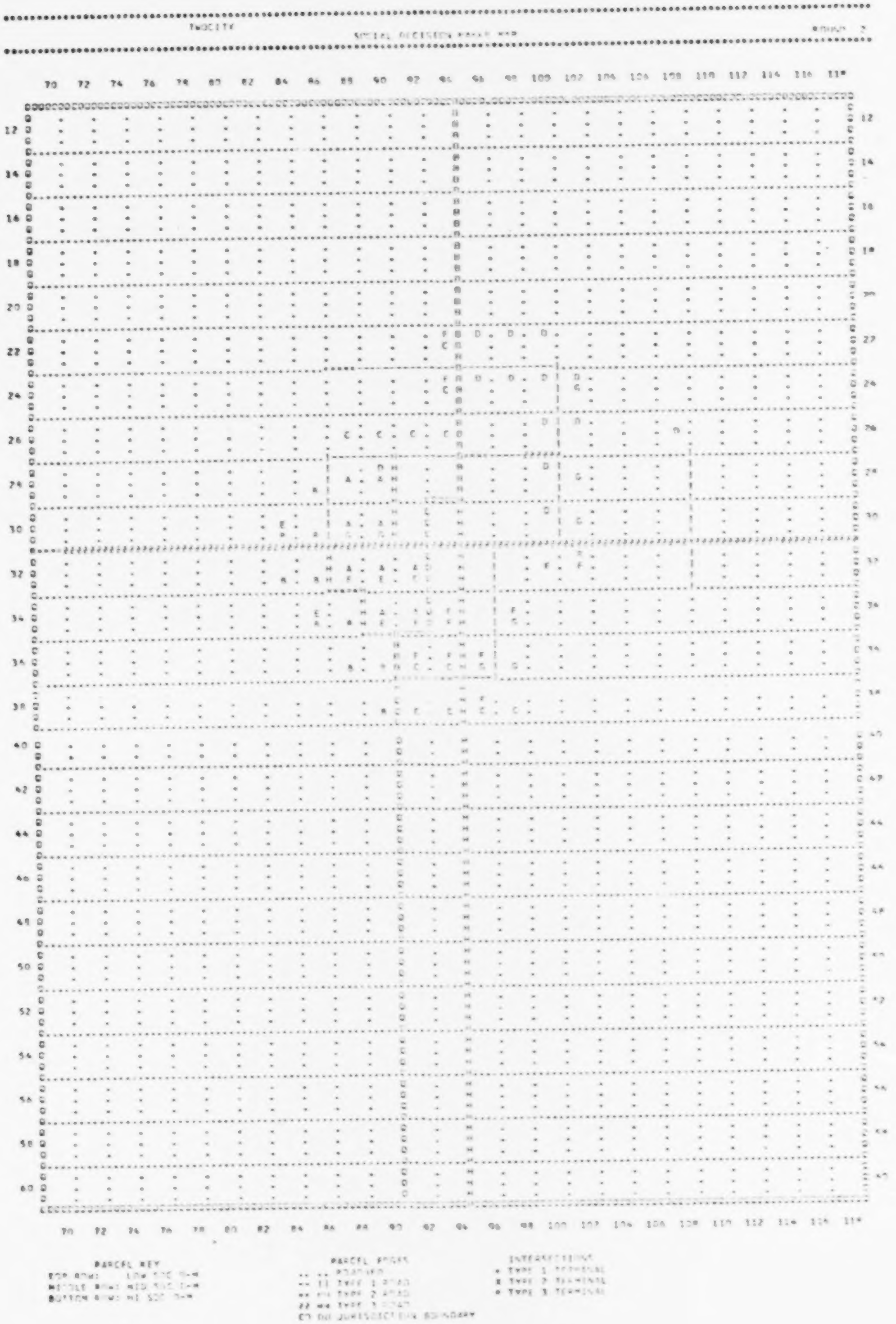

TWOCITY
TOPOGRAPHICAL RESTRICTION MAP
ROUND 2
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
PARCEL KEY
PERCENT TOPOGRAPHICALLY UNDEVELOPABLE
PARCEL EDGES
.. .. ROADLESS
— II TYPE 1 ROAD
== HH TYPE 2 ROAD
## WW TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
* TYPE 3 TERMINAL

17. Social Decision Maker Map

This map indicates which social players make decisions for the low, middle, and high income population units on parcels. The top letter on a given parcel represents the social decision-maker who controls the PL's who live there, and the middle and lower letters represent the social decision-makers who control the PM's and PH's, respectively, who live there. If a particular class does not live on a parcel, no letter is printed.

Not until a parcel is developed for residential land use and occupied by at least one income class, will a social decision-maker for that parcel appear on the map. Note that different decision-makers may control the different population classes on a single parcel. Social teams acquire control over additional Pl's on a parcel when the number of Pl's of that class moving into the parcel exceeds the number moving out. Social teams may find that from round to round they gain or lose control of population units on a residential parcel of land. This occurs as a result of the migration of Pl's of a class to a parcel where previously there were no Pl's of that class (a gain) or as a result of the migration away from a parcel of all the Pl's of a class on that parcel.

Figure 10.24


TWOCITY
SOCIAL DECISION PANEL MAP
ROUND 2
PARCEL KEY
TOP ROW: LOW SOC D-M
MIDDLE ROW: MID SOC D-M
BOTTOM ROW: HI SOC D-M
PARCEL EDGES
.. .. ROADLESS
-- II TYPE 1 ROAD
** HH TYPE 2 ROAD
## ** TYPE 3 ROAD
CD DD JURISDICTION BOUNDARY
INTERSECTIONS
* TYPE 1 TERMINAL
# TYPE 2 TERMINAL
* TYPE 3 TERMINAL

C. Summary Information

1. Demographic and Economic Statistics

The output summarizes a wide variety of information about the simulated region. There are two basic types of information: statistics by jurisdiction and for the region as a whole about local conditions, and measures of interactions between the region and the Outside System. The former provide comparisons between jurisdictions; the latter provide comparisons between the local and Outside systems.

Statistics Regarding Local Conditions

Total population: the number of people (not Pl's), by class.

Percent change over previous year: the total population change, positive or negative, between the current round and the previous round. This is the only local statistic which is given only as a total and not broken down by jurisdiction.

Average population per parcel: the number of people divided by the number of parcels.

Developed land (in parcels): the amount of land area (in parcel equivalents) consumed by public and private developments.

Undeveloped land: the amount of land area (in parcel equivalents) not consumed by developments.

Total land area: the number of parcels.
Assessed value of land in millions: the property tax base.
Assessed value of developments in millions: the development tax base.

Average quality of life index: a measure across classes of the people's average quality of life index. The higher the index, the poorer the quality of life. The indexes may differ significantly within a jurisdiction, but only averages are given here.

Number of registered voters: the number of people eligible to vote, from which the number who actually vote are selected.

Figure - 9.1

```
    TWOCITY
               DEMOGRAPHIC AND ECONOMIC STATISTICS                                                ROUND  1
*****************************************************************************************************************

                                                                    JURISDICTION   JURISDICTION   JURISDICTION
                                                    TOTAL                I              II             III
  ****************************************       **********       **********     **********     **********

  TOTAL POPULATION                                 275500            126000         149500              0
                         LOW    CLASS               73500                 0          73500              0
                         MIDDLE CLASS               99000             64000          35000              0
                         HIGH   CLASS              103000             62000          41000              0

  PERCENT CHANGE OVER PREVIOUS YEAR                     0
  AVERAGE POPULATION PER PARCEL                         0                 0              0              0

  DEVELOPED LAND (IN PARCELS)                          77                30             46              0
  UNDEVELOPED LAND                                    548               266            283              0
  TOTAL LAND AREA                                     625               296            329              0

  ASSESSED VALUE OF LAND                           12312.             5321.          6992.             0.
      IN MILLIONS

  ASSESSED VALUE OF DEVELOPMENTS                     421.              158.           264.             0.
      IN MILLIONS
  AVERAGE QUALITY OF LIFE INDEX                        69                61             75              0
  NUMBER OF REGISTERED VOTERS                       88573             45566          43007              0
  NO. IN PUBLIC ADULT EDUCATION                         0                 0              0              0

  AVERAGE EDUCATIONAL LEVEL                            59                73             47              0
      LOW                                              17                 0             17              0
      MIDDLE                                           61                61             62              0
      HIGH                                        5332824           4061270         278305              0


  NO. OF WORKERS RECEIVING WELFARE                  12800                 0          12800              0

  STUDENT/TEACHER RATIO                                 7                13             10              0

  SCHOOL ENROLLMENT
      PUBLIC                                        48740             34040          14700              0
      PRIVATE                                       20460                 0          20460              0

  HOUSING UNITS
      SINGLE    DWELLINGS                             100                62             38              0
      MULTIPLE  DWELLINGS                              24                 7             17              0
      HIGH RISE APARTMENTS                              6                 4              2              0

  VACANCY RATE        (PERCENT)                         4                28            -23              0
      NEGATIVE MEANS OVERCROWDED
```

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Figure - 9.1 (Cont'd)

```
NUMBER OF EMPLOYED WORKERS                79400          35360       44040        0
     LOW                                  23000              0       23000        0
     MIDDLE                               31680          20480       11200        0
     HIGH                                 24720          14880        9840        0


NUMBER EMPLOYED IN
     LIGHT      INDUSTRY                  27160          10240       16920        0
     HEAVY      INDUSTRY                  27760          11800       15960        0
     NATIONAL   SERVICES                      0              0           0        0
     CONSTRUCTION INDUSTRY                    0              0           0        0
     BUSINESS   GOODS                      2800           1680        1120        0
     BUSINESS   SERVICES                   5240              0        5240        0
     PERSONAL   GOODS                      3360           3360           0        0
     PERSONAL   SERVICES                   5680           2480        3200        0
     MUNICIPAL SERVICES                    1920           1920           0        0
     SCHOOLS                               3880           3880           0        0
     RAIL                                     0              0           0        0
     BUS                                      0              0           0        0
     FEDERAL-STATE                         1600              0        1600        0

NUMBER OF UNEMPLOYED WORKERS               6400              0        6400        0
     LOW                                   6400              0        6400        0
     MIDDLE                                   0              0           0        0
     HIGH                                     0              0           0        0


UNEMPLOYMENT RATE   (PERCENT)              7.46            0.0       12.69      0.0
     LOW                                  21.77            0.0       21.77      0.0
     MIDDLE                                 0.0            0.0         0.0      0.0
     HIGH                                   0.0            0.0         0.0      0.0

PERCENT EARNING       UNDER $ 5,000          33              5          55        0
PERCENT EARNING $5,000 TO $10,000            37             54          22        0
PERCENT EARNING        OVER $10,000          29             39          21        0
```

Number in public adult education: the number of people who wanted to participate in public adult education programs and were able to do so because programs were provided by their school departments.

Average educational level: by class, the average educational level. This ranges from 0 to 100. The higher a worker's educational level relative to those of other workers, the greater his chances of being hired before the others.

Number of workers receiving welfare: if a jurisdiction does have a program for aid to the unemployed, this number is the number of unemployed workers. The number is zero if there are either no unemployed workers or no welfare program.

Student/teacher ratio: ratio of number of students attending local public schools to number of teachers employed by public schools. This is a factor when students are allocated to public or private schools.

School enrollment: the number of students attending local public schools and the number attending private schools. Students attend private schools only if the public schools in their districts are inadequate.

Housing units: the number of levels of RA (single family), RB (town house, multiple dwellings), and RC (high rise) housing.

Vacancy rate: the ratio of existing housing space to housing space occupied, expressed as a percent. A negative rate means that housing is overcrowded.

Number of employed workers: the number of people holding full-time jobs, by class of worker.

Number employed by type of employer: the number of full-time workers employed by each type of business and government employer.

Number of unemployed workers: by class, the number of workers seeking full-time employment who were unable to obtain jobs.

Unemployment rate (percent): by class, the number of unemployed workers as a percent of the total number of workers who sought full-time jobs.

Earning distribution: the percent of workers earning less than $5,000, between $5,000 and $10,000, and over $10,000 from full-time employment.

Transactions with the National Economy

Income from the national economy: federal-state aid recieved, by type of aid, and income from both basic industry sales of ouput and bus and rail sales of equipment.

Sales to the national economy: federal-state taxes paid, by type of tax, and purchases of goods, services, and outside-owned land. The only Outside expenditure which can be significantly controlled locally is the purchase of goods and services due to local insufficiency.

National economy business cycle: last round's ratio to "typical income" per unit of output for basic industry, interest rates on loans and bonds from the Outside (expressed as percents), and the average rate of return on outside investments (expressed as percents).

2. Summary Information for the Economic Sector

Number of Levels of Economic Activity Owned by Teams

The table contains one row per economic team and one column for each type of economic activity. Each entry in the table is the number of levels of an activity controlled by an economic team in the simulated region. The last column, UN, is the number of undeveloped parcels which the team owns. The table provides a simple summary of how economic decision authority is currently distributed. It may be observed whether certain teams are specializing or not, whether certain types of businesses exist at all in the region, and in general, how much economic activity is going on.

Economic Control Summary (one table per economic decision-maker)

This table provides a simplified picture of the status of each business and residence controlled by the team. There is one row per economic activity. The first two columns show the coordinates and type and level of the activity.

The third column is the production idex, if the activity is a business, or the occupancy rate, if the activity is a residence. A residence's occupancy is expressed as a percent of its capacity. A residence can be occupied by to 120% of its capacity. The greater the occupancy, the more income earned by the owner from rents. A business's production index is a measure of its actual output or capacity as a percent of its maximum output or capacity. In the case of a basic industry, the index is the number of units it actually produced as a percent of its design capacity. The production index of a commercial

Figure 7.1

```
**************************************************************************************************************
                              TWOCITY
                 NUMBER OF LEVELS OF ECONOMIC ACTIVITY OWNED BY TEAMS                                  ROUND  2
**************************************************************************************************************

TEAM    FL    SG    MP    MF    NL    EL    TE    FO    TA    PA    CR    NS    BG    BS    PG    PS    CT    RA    RB    RC    UN
----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----

 A       0     0     1     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0    11
                     -                                                                                                        --
 B       0     0     0     0     0     0     0     0     0     0     0     0     0     1     0     1     0    11     3     1     5
                                                                                     -           -          --     -     -     -
 C       0     0     0     0     0     0     0     0     0     0     0     0     1     0     0     0     0    10     4     1     5
                                                                               -                            --     -     -     -
 D       0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0    25     7     2     3
                                                                                                            --     -     -     -
 E       0     0     0     0     0     0     0     0     0     0     0     0     0     0     1     0     0    19     1     1     3
                                                                                           -                --     -     -     -
 F       0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0    29     7     1     4
                                                                                                            --     -     -     -
 G       0     0     0     0     0     0     1     1     0     1     0     0     0     0     0     0     0     6     2     0     4
                                         -     -           -                                                 -     -           -
```

Figure - 7.3

```
*******************************************************************
        TWOCITY
   ECONOMIC CONTROL SUMMARY   TEAM G                       ROUND  2
*******************************************************************


                           PRODUCTION INDEX                           RATE
  PARCEL                          OR                                   OF
 LOCATION     ACTIVITY      OCCUPANCY RATE          NET INCOME       RETURN


   9822         RA 2             100                     282496       19.28%

  10224         RA 4             117                     764963       23.91%

  10026         RB 2             117                    -135668       -1.67%

   9828         TE 1             100                   23406766       13.00%

   9630         PA 1              96                   77502504       32.29%

   9432         FO 1             100                   68745011       29.89%
```

establishment is its effective capacity (the amount which it can adequately serve) to its design capacity. A production index of 100 is the highest which a business can have.

The fourth column, net income, is a business's total income from sales or a residence's total income from rents, less operating expenditures.

The last column, rate of return, is perhaps the most information single indicator of an activity's status. Rate of return is the net income as a percent of the development cost, and if a business is doing reasonably well, it usually averages around 10-25%. A decision-maker may use rates of return as guides for deciding which activities to focus his attention on.

Further detail on rate of return is contained in the section describing Economic Detailed Output.

Economic Control Summary (two graphs per economic decision-maker)

The two graphs printed for each economic decision-maker show an historical comparison of two types of information: net worth and rate of return. Whereas net worth is the team's total net worth (assets less liabilities), the information on rate of return is the average rate of return of all of the activities controlled by the team. The graphs show the relative values of those items for the most recent ten years. Round 1 is Year 5 on the graph, Round 2 is Year 6, and so on. After 6 rounds have been played (years 5 through 10 on the graph), the date for the earliest year are erased and only data for the most current 10 years are shown. Year 10 is always the most recent round.

On the net worth graph, the team's net worth for each year is shown as a ratio to its net worth in the first year. The first year is always 1.00. The second graph shows the team's average rate of return as an absolute percent, not relative to a base year.

Figure 7.6a

Economic Graphs for Teams: Net Worth

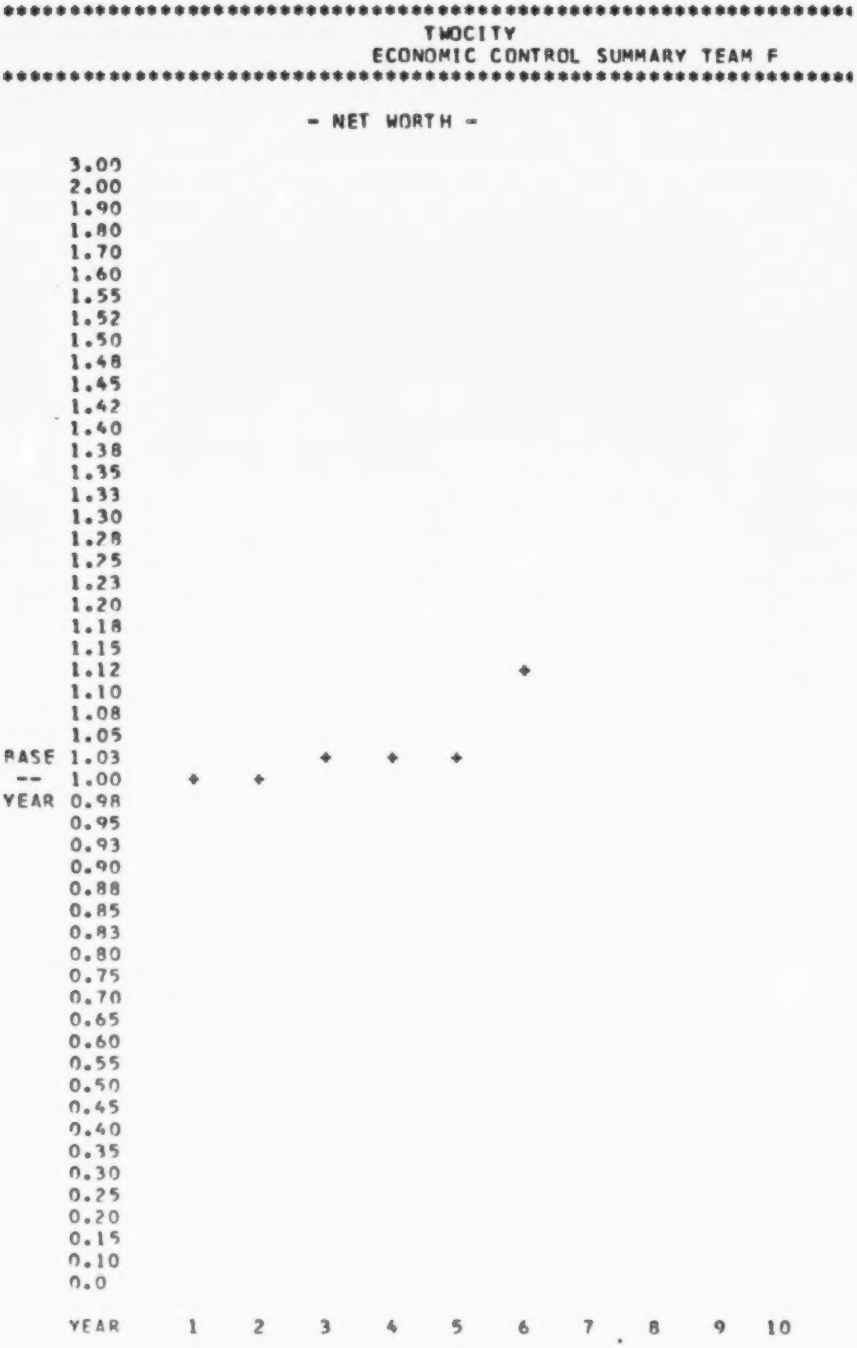
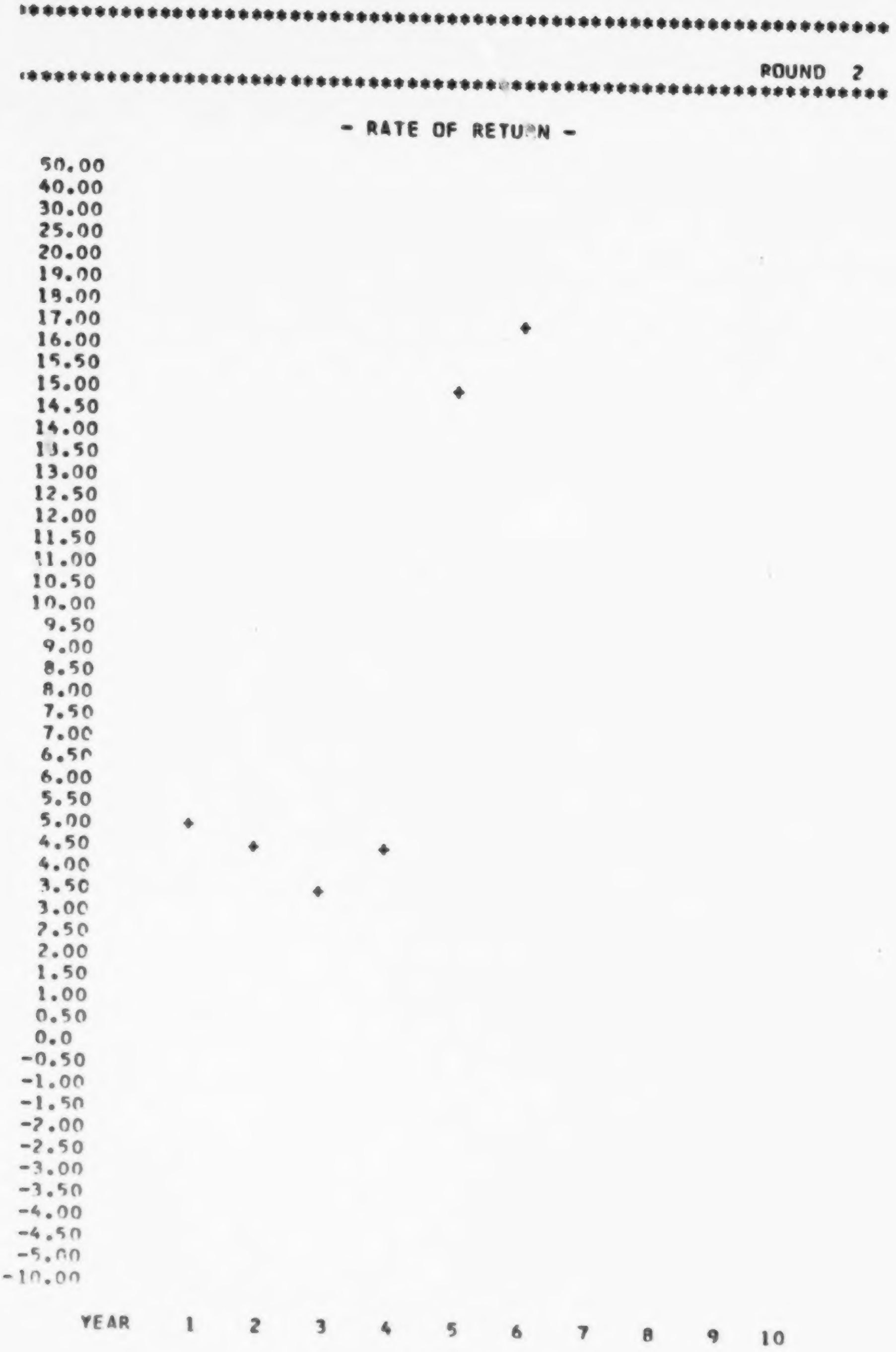


Figure 7.6b

Economic Graphs for Teams: Rate of Return



D. Economic Sector Detailed Output

1. Financial Summary

a. Cash Flow Statement

A team's cash holdings can be used to purchase additional property, construct any of the types of economic sector land uses on property that it owns and which is properly zoned and served with utilities, construct any level or type of effluent treatment plant at a business which it owns, demolish any building it owns, pay off loans, grant a loan to another team, pay taxes on undeveloped land, or spend it in some miscellaneous way (cash transfer to another team and purchase of national stocks).

Additions to the new balance (i.e., cash) come from income derived by selling property, receiving payment from loans, receiving loans, earning net income from investments (developments and farms) in the local economy, receiving government subsidies, earning interest on savings,* and from miscellaneous sources (cash transfers from others and sale of national stocks).

If the team makes no decisions during a particular round, it is still charged interest and principal payments on loans and taxes on undeveloped land. The team also automatically receives loan payments, interest on savings, and net income. This latter figure, however, may be a negative number if the developments of a given team are doing poor business and their expenses exceed income.

---

*Interest earned on savings is 2.5 percent. The calculation of interest on savings is:

PCB = previous cash balance
N = total net income from businesses this round
E = total expenditures this round, except expenditures for business operation, which are already accounted for in N.
Interest = .025 (PCB + N - E).

Figure 6.9

```
****************************************************************
       TWOCITY
    FINANCIAL SUMMARY--ECONOMIC DECISION MAKER A         ROUND  2
****************************************************************

       CASH FLOW STATEMENT
       -------------------


         PREVIOUS CASH BALANCE                   $       180000000.

             EXPENDITURE
                  PROPERTY PURCHASED             $            8080.
                  CONSTRUCTION                   $       256000000.
                  DEMOLITION                     $         9599999.
                  LOAN PAYMENTS                  $         6191512.
                  NEW LOANS GRANTED              $               0.
                  UNDEV LAND TAXES               $         6640346.
                  MISCELLANEOUS                  $        10000000.


             INCOME
                  PROPERTY SOLD                  $           97000.
                  LOAN PAYMENTS RECEIVED         $         2757808.
                  LOANS RECEIVED                 $               0.
                  TOTAL NET INCOME               $        53077792.
                  SUBSIDIES                      $               0.
                  INTEREST ON SAVINGS            $               0.
                  MISCELLANEOUS                  $       800080000.


            NEW BALANCE                          $       747572736.


                  CONSERVATIVE INVESTMENTS          $              0.
                       INCLUDING A RETURN OF     $               0.
                  SPECULATIVE INVESTMENTS           $              0.
                       INCLUDING A RETURN OF     $               0.

         TOTAL ASSETS                            $      1488160256.
                  CASH                           $               0.
                  LOANS TO OTHERS                $         4999999.
                  INVESTMENTS IN OUTSIDE         $               0.
                  DEVELOPMENTS                   $       240000000.
                  LAND                           $       495587594.



         LIABILITIES (INDEBTEDNESS)              $        76074384.
         NET WORTH                               $      1412085760.


     NEW BORROWING CAPABILITY FROM OUTSIDE $            1114453504.
```

b. Investments

The second part of the Financial Summary output shows investments in the national economy. A team may invest as much cash as it wishes in either conservative or speculative national businesses. The national business cycle generates the year by year rate of return for conservative stocks and for speculative stocks. In upswings in the business cycle, the rate of return on speculative stocks will always be larger. The range for the rate of return on conservative stocks is narrow and centers on six percent whereas for speculative stocks the range is wide and it centers on about seven percent. In bad years, however, the return on speculative stocks could be very small or even negative. The return from national investments is automatically used to purchase additional stock. A team must "dis-invest" in order to have returns from national investments show up in the cash account.

c. Balance Sheet

A team's assets are comprised of cash on hand, loans to others, the value of investments in the national economy, and the value of developments and land. Developments are valued at their typical construction costs times their value ratio divided by 100. Thus, developments that are not maintained decrease in value over time. Land is valued at the market value.

A team's liabilities are the sum of the principal on all loans from others (indebtedness). Net worth is the difference between current assets and liabilities. Teams may borrow up to 80% of their total assets from national bankers. The amount which a team can borrow from outside is shown on the last line of this output. There are no limits on the amount of debt that teams may have among themselves.

2. Economic Control Summary

This output summarizes the economic status of the non-farm developments owned by a team. Under PARCEL LOCATION, all the locations of non-farm economic activities (residences, industries, and commercial establishments) are listed in increasing order of the second coordinate number. Actually, the properties are listed in the same order that they would read from a map if the map were read from top to bottom and from left to right.

The two-digit code for the type of economic activity and its level of development are listed in the ACTIVITY column. Check the detailed output for each industry to see if the operating level equals the development level. Only basic industries are allowed to operate at a level lower than their development level.

In the third column, the production index (for industries or commercial establishments) or the occupancy rate (for residences) is listed. The production index may never exceed 100. It is equal to 100 if the business receives all of the employees it needs and if the value ratio is equal to 100. Otherwise, it is less than 100. The occupancy rate for residences is an indicator of vacancies (if less than 100) or overcrowding (if over 100).

The NET INCOME column shows the dollar amount by which income from the activity (in the form of rents received or goods or services sold) exceeds the expenditures associated with that activity. A negative number indicates that expenditures are greater in that year than income.

The RATE OF RETURN is the net income of the activity expressed as a percentage of the current value of the activity. The current value of an activity is the original value of the development times its present value ratio divided by 100, plus the market value of the percent of the parcel consumed by the development. Note that the rate of return does not take into account the value or cost of the portion of the parcel not used by the development. It also does not take into account the cost of borrowing money (or opportunity costs) to construct the development in the first place. Therefore, the printed rate of return should be looked at as a slightly inflated figure.

Figure 7.3

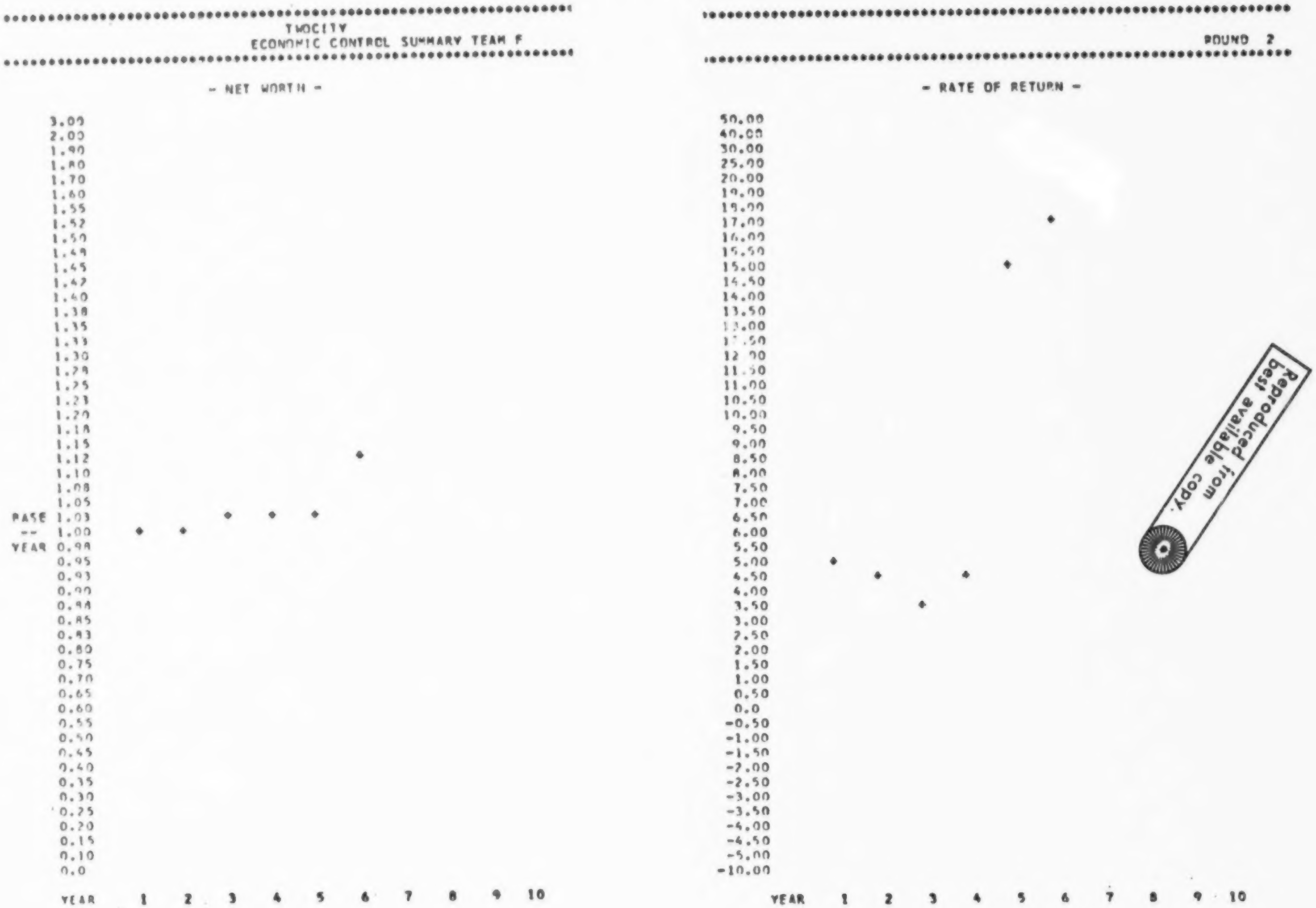
```
****************************************************************
          TWOCITY
    ECONOMIC CONTROL SUMMARY   TEAM G                   ROUND  2
****************************************************************


                            PRODUCTION INDEX                       RATE
  PARCEL                          OR                                OF
 LOCATION     ACTIVITY      OCCUPANCY RATE          NET INCOME    RETURN


   9822        RA 2              100                  282496      19.28%

  10224        RA 4              117                  764963      23.91%

  10026        RB 2              117                 -135668      -1.67%

   9828        TE 1              100                23406766      13.00%

   9630        PA 1               96                77502504      32.29%

   9432        FO 1              100                68745011      29.89%
```

3. Economic Graphs

The net worth graph shows the historical trend in the net worth for the team. The net worth value for the past round is the same as the net worth value shown on the team's Financial Summary.

The rate of return graph shows the historical trend for the aggregate rate of return for the team. The aggregate rate of return is the net income received by the team during the round divided by the value of developments and developed land.

Figure 7.6



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4. Loan Statement

The loans that a team has with national bankers (outside = OU) and with other teams are shown in the loan statement. The loans received from other sources are listed and their annual payments summarized. The loans granted to other teams are listed after that. Note that the interest rate may vary by loan.

Loans between teams are made for any amount and at whatever interest rate is mutually agreeable. The only conditions on a loan internal to the system is that the period be specified as either 2 or 25 years, and that the lending team have sufficient cash to cover the loan.

An economic team may also borrow money from the outside system for either a 2 or 25 year period. The interest rate is set by the national bankers who take into consideration the national business cycle. An economic team that has debts equalling 80% of its total assets may not receive any further loans from the outside system.

Figure 6.8

```
**********************************************************************
            TWOCITY
       LOAN STATEMENT--ECONOMIC DECISION MAKER A
                                                            ROUND  2
**********************************************************************


BORROWER        LENDER        INTEREST        REMAINING    ORIGINAL         ANNUAL
                              RATE            YEARS        PRINCIPAL        PAYMENT
--------        ------        --------        ---------    ---------        -------

   A              DU             3.5             23      $  75000000      $  4550592
   A              G              6.2              1      $   3000000      $  1640920
                                                                          ---------
                                                              TOTAL       $  6191512


   E              A              6.8              1      $   5000000      $  2757808
                                                                          ---------
                                                              TOTAL       $  2757808
```

5. Land Summary

The Land Summary output shows the location by parcel coordinates of all land owned by a team. It also shows the assessed value of the entire parcel (assuming that 100% of the parcel is valued in the same proportion as the private part), the publicly owned part (percent developed and undeveloped), the undevelopable percent, the number of units of utility service available to that parcel, and the actual number of utility units that are used.

Teams may acquire land from other players at mutually agreeable terms or from the director on a bid submission basis. The director represents small farmers and outside land holders who will sell if the price is right. The game director controls the sale of Outside-owned land.

The cost of making land bids on Outside-owned properties is set at some percent of the bid amount, regardless of the bid's success or failure (See Economic Sector Master Tables).

6. New Construction Table

The new construction output shows for an economic decision-maker the location at which a new development or an additional level of development is taking place. It also shows the type of development, the old and new level, the location of 0-0 which denotes an outside system firm, the contract price, the rent per space unit (if a residence) or the salary by class (if an employer), the quality index (if housing) or the price per CU (if a store), and the contract status. "Completed" means that the development became operational at the beginning of the round just completed.

7. Economic Boycott

Economic teams may boycott the purchase of goods or services from local BG, BS, PG, and/or PS establishments, and their businesses can be boycotted by the social sector as a place to work or shop. Boycotts have effect for the full round, and they continue in operation for succeeding rounds unless terminated by a decision input on the part of the boycotting team. The boycott output shows the team boycotting, the income class or land use that is carrying out the boycott, and the function being boycotted (work or shop). The boycott output also shows the location and land use being boycotted, and the team owning the boycotted business.

Thus, boycott information appears as part of an economic decision-maker's output if he is boycotting and/or if he is being boycotted.

Figure 6.5

```
*******************************************************************
        TWOCITY
  ECONOMIC DECISION MAKER A    BOYCOTT STATUS OUTPUT         ROUND  2
*******************************************************************


                  BOYCOTTING                              BOYCOTTED
                  ----------                              ---------
                CLASS OR
      TEAM      LAND USE     FUNCTION        LOCATION     LAND USE     OWNER
      ----      --------     --------        --------     --------     -----

       A         MF            SHOP            9830          BG          C

       A         FO            SHOP            9830          BG          C
```

8. Farm Output

The farm output shows for each farm, the farm code number, the type of farm, the number of parcels comprising the farm, the total number of percents of parcels comprising the farm, the farm's fertilizer level, the normal income per 1% of that farm (at fertilizer level zero and before local property taxes are deducted), the multiplier on normal income for each of the three other possible fertilizer levels, the actual income per 1% of that farm (before taxes), the total local property tax paid, and the total net income earned from the farm.

An economic decision-maker can make two types of decisions regarding farms: 1) set the fertilizer level at each farm; and 2) sell land on farm parcels. The higher the fertilizer level at a farm, the higher the actual net income before taxes and the greater the amount of pollution in the farm's runoff. A farm owner can either sell all of the farmland on a farm parcel to another economic decision-maker (in which case the parcel ceases to be classified as a farm) or sell part of the parcel to a government department.

The farm code number and farm type are fixed at the beginning of a game. They cannot be changed. The number of parcels and percents of parcels comprising a farm can be decreased but not increased by the farm owner. The normal income before taxes per 1% of a farm is also fixed at the start of a game. That income is multiplied by the multiplier associated with the farm's fertilizer level to yield the actual income before taxes. The assessed value of farm parcels and property tax rates are set by the local government. The actual income before taxes is multiplied by the number of percents in the farm and the total land tax paid is subtracted from that result to yield the total net income.

9. Residence Detailed Output

The Residence Output shows the location, type and level of each residential complex owned by a team. All residences in the model are described as rental units, although the rent on single family housing could be viewed as a form of mortgage payment. Although the construction and operation of housing is a player decision, the process that moves population units into housing is performed by the computer and is affected by player decisions in the economic and governmental sectors.

The economic decision-maker directly controls the rent of housing and its quality index (by changing the maintenance level). Government decision-makers affect the quality of municipal services and schools serving each residence and the tax rate and welfare rate for the jurisdiction containing each residence. Both government and economic decision-makers affect the water quality on a parcel. All of these factors are taken into consideration by the computer when assigning population units to available housing.

a. The Quality Index and Maintenance Level

The quality index of a residence is a measure of the present value of a development to the best possible value which a residence can have. The Social Sector Master Table shows that PH's require a quality index of at least 70, PM's a value of 40, and PL's a value of 20. This does not mean, however, that all Pl's of a given class automatically move out of housing when the quality index falls below the minimum value. They just won't move in, and they tend to move out because of increased dissatisfaction.

The quality index declines each year in response to time, the quality of local municipal services, increased fire damage due to insufficient water supply, and damage due to floods, unless maintenance is performed on the residence. The maintenance level indicates the lowest level the owner of the residence will allow the quality index to fall before incurring maintenance expenses. The quality index can be raised above its present level by the player inputting a main-

Figure 6.2

```
**********************************************************************
   TWOCITY
 ECONOMIC DECISION MAKER F   RESIDENCE OUTPUT              ROUND  2
**********************************************************************


         LOCATION                               9232            8634
         TYPE AND LEVEL                         RC 1            RA 4
         QUALITY INDEX                            80              75
         MAINTENANCE LEVEL                        80              75
         MS DISTRICT                               1               1
         UTILITY DISTRICT                          1               1

         DEPRECIATION (%)
              MS                                 1.0             1.0
              FIRE                               0.0             0.0
              FLOOD                              0.0             0.0

         WATER CONSUMPTION (MGD)
              MUNICIPAL                         0.96            0.39
              OUTSIDE                           0.0             0.0

         OCCUPANTS                            8M 12H          1M  4H
         PERCENT OCCUPANCY                        69             117
         RENT/SPACE UNIT                      153000          154000

          INCOME
              RENT                           5304000         1437333

          EXPENDITURES
              MAINTENANCE                    1238000          118800
              UTILITIES                      1134900          155200
              WATER                           155520           34390
              PROPERTY TAXES                  512244           74368
              INCOME TAXES                    875000          309750
              SALES TAXES                      54010            5186

         NET INCOME                          1334326          739649

         RATE OF RETURN                         5.93           21.13

         ENVIRONMENTAL INDEXES
             LOW INCOME                          332             268
             MIDDLE INCOME                       306             246
             HIGH INCOME                         310             248
```

tenance level that is higher than the quality index. The quality index may not be raised more than 20 points above the lowest level it has ever reached.

b. MS District

As was mentioned above, the quality of the municipal services (as measured by the MS use index) serving a residence has an effect on the attractiveness of that residence to potential occupants and on the rate of depreciation (decline in quality index) for that residence. The residence output shows the code number of the municipal service unit that serves each residence. The use index of each MS district is shown on the Municipal Services Report and on the Municipal Services Map. An MS use index value of 101 or more indicates overcapacity and means that the municipal services supplied are less than adequate. As the MS use index increases above 101, the residences served by that MS building become less and less attractive to P1's and the residences also depreciate at a faster and faster rate. For example, a use index of 150 is twice as bad as a use index of 125 and five times as bad as a use index of 110.

c. Utility District

Utility districts provide water and sewer services in addition to other utilities. If a district provides an insufficient amount of water for its users' needs, the fire protection afforded those users is inadequate. That inadequacy is reflected in an increased depreciation for all economic activities in the district. A water shortage can occur for any of the following reasons: 1) the intake water quality is 9 and therefore untreatable; 2) there is insufficient water for all of the users' needs; or 3) the district's intake treatment plant has the capacity to treat less water than its users need.

The residence output shows the code number of the utility district serving each residence parcel.

d. Depreciation

A residence has a normal annual depreciation, depending on its type (see Master Tables for depreciation rates). As mentioned above, it can also depreciate due to inadequate municipal services and/or inadequate fire protection. Another factor in depreciation is flooding. The director specifies when floods occur and a general degree of flooding. The degree of damage to the economic activity on a particular parcel is influenced by three additional factors: 1) the type of activity; 2) the river basin dam priorities; and 3) the likelihood of the parcel being affected by a flood. This last factor is called the parcel's flood susceptibility and can be found on the River Basin Flood Plain Map. A parcel having zero flood susceptibility is never affected by floods; a parcel having a susceptibility of three is among the most affected parcels. The parameters for the other factors in depreciation can be found on the Master Tables.

The amount of depreciation due to MS, fire, and flood is printed in percent of the activity's original value, assumed to be 100%.

e. Water Consumption

A residence normally receives all of its required water from a municipal source (its utility district). However, there are two exceptions: 1) when the utility district provides insufficient water for its users' needs (see c. above); and 2) when a residence is served by private utilities. Type RA residences can be constructed without having utility service. It is assumed that they have wells and septic tanks. They do pay an expense for water, but that amount is paid to the Outside and is lower than the normal Outside price for water. A residence supplied by a municipal water source receives water from Outside only when the local supply is inadequate. When such occurs, each residence receives an amount of water proportionate to its needs. For example if the needs of all of the water users in a utility totaled to 24 MGD and the district was only able to supply 16 MGD (67%), a residence needing 3 MGD would receive 2 MGD from the district (67%).

The amount of water required by a residence is a function of the residence type and class of occupants. In general, a high-income P1 uses more water than an RC dweller. See the Master Tables for specific water requirements by class and residence type.

The residence output shows the amount of water obtained from municipal and Outside sources.

f. Occupants, Percent Occupancy, and Rent/Space Unit

The residence output shows the number of P1's of each class that occupy every residence. PH's and PL's may never live together on the same residence parcel. The percent of occupancy is determined by taking the number of P1's by class, multiplying times their residence space consumption index (Social Sector Master Table), and taking this as a ratio of the total space units in the residence.

For example, assume an RA3 has one PH and two PM's occupying it. The PH has a space consumption index of 2 and the two PM's together a space consumption index of 2.66 (2 x 1.33). Thus, there are 4.66 space units being occupied from an RA3 that has 6.00 space units of capacity. The occupancy rate is therefore 4.66/6 = .78, or the building is 78 percent occupied.

Rents are always specified in terms of the rent paid per space unit. A PM pays 1.33 times the per space unit rent, and a PH pays twice as much.

g. Income

The income earned by a residential unit is equal to the rent per space unit times the total number of space units occupied. In the above example, 4.66 space units were occupied, therefore, at a rent of $150,000 per space unit the rental income would be $699,000.

Income earned from a residence is independent of which classes occupy it; income is directly related to the percent which a residence is occupied and the rent being charged. The following example illustrates that point.

Income Earned from Housing Occupied by the Three Income Classes

Assume: Housing is an RA2
Rent specified is $150,000/space unit

Class	Relative Space Units Consumed	Number of Pl's Occupying an RA2 (2X Relative Space Units	Rent Paid Relative	Rent Paid Factor (Pl's x Rent Paid Relative)	Rent Paid (Rent Paid Factor x Rent Charges)
PH	1.0	2	2.00	4	$600,000
PM	1.5	3	1.33	4	$600,000
PL	2.0	4	1.00	4	$600,000

h. Expenditures

The owners of residences incur expenditures for maintenance, utilities, water, property taxes, income taxes, and sales taxes. A residence's maintenance expenditure is the sum of its expenditures for personal goods and personal services. The number of consumption units required for maintenance is a function of the total percent depreciation, the level of the residence, and the number of PG and PS units required for each percent depreciation. The number of units of PG and PS required for each percent depreciation is given on the Master Tables. The normal percent depreciation is also on the Master Tables, and depreciation due to other factors is on the residence output. Suppose that the RA3 mentioned above has a normal depreciation of 1% and has 2.5% more depreciation due to the other factors. Total depreciation: 3.5%. Suppose also that RA requires .7 PG units and .3 PS units per 1% depreciation. Assume that the residence owner has set a maintenance level which offsets that depreciation. The residence's PG consumption is: 3.5 x .7 x 3 = 7.35, or 7 PG units. Its PS consumption is: 3.5 x .3 x 3 = 3.15, or 3 PS units. The actual price paid per consumption unit depends on where the residence purchases PG and PS. That can be determined by examining the Commercial Detail Output.

The expenditure for utilities depends upon the number of utility units consumed by type and level of residence (see the Economic Master Table) and the cost per unit of utility service as established by the Utility Department. If the cost of utility service were $10,000 per unit, and an RA3 consumed 12 units per year, its utility cost would be $120,000.

Although Pl's consume water, residence owners pay for the water. Local water prices per million gallons consumed in a year are set by the Utility Department for each economic activity. The prices for residences are set by class and by residence type. The residence owner pays the local price for that amount of water which is obtained from the Utility Department and pays the Outside price for the amount not supplied by the Utility Department (see Master Tables for Outside prices).

The pricing is relatively straightforward. For example, suppose an RA3 houses 2 PH and 1PM. Assume the Master Table shows that, in RA housing, a PH requires .08 MGD and consumes 29 MG in a year, and a PM requires .07 MGD and consumes 25 MG in a year. Suppose the total amount of water required by the water users in the utility district is 24 MGD but the district can supply only 16 MGD (67%). The residence output would show .15 MGD obtained from the municipal source (16/24 x (.08 + .08 + .07)) and .08MGD from Outside (.08 + .08 + .07 - .15). The total amount obtained from both sources equals the total amount required by the residence.

Whereas the daily requirement is used for determining local water sufficiency, the billing is done on an annual basis in proportion to the amount obtained from each source daily. Suppose the local price per MG for PH in RA is $350. Let the Outside price, which is always the same for all water users, be $700 per MG. Then the residence owner's water expenditure for Outside water is:

$$8/24 \times (29 + 29 + 25) \times \$700 = 19{,}366$$

The proportion purchased daily from outside is multiplied by the total annual requirement and the Outside cost per MG. The owner's payment to the local Utility Department is:

$$16/24 \times (29 + 29) \times \$450 + 16/24 \times 25 \times \$350 =$$
$$\$8700 + 5833 = \$14{,}533$$

Residences pay property tax on the assessed value of the building and the land occupied by the building. The Assessment Department has control over land and building assessments and the Chairman and Council have control over the tax rates which are applied to the assessed value.

Residences pay income taxes on the same basis as all other economic businesses -- a federal tax of 22% on the first $25,000 of net income before taxes and of 48% on the rest of net income and a state tax of 5% on net income (after federal income taxes).

Residences pay sales taxes on the purchases from PG and PS for maintenance. The fixed state sales tax is 3% of PG and PS purchases and the local sales tax is whatever rate has been determined by the local sales tax authorities. Sales taxes accrue to the jurisdiction of the commercial establishment and not to the jurisdiction of the residence. State sales taxes are paid on purchases from the outside system as well as on local purchases.

i. Net Income

The final net income for residences is determined by subtracting all of the listed expenditures from the income derived through rents.

j. Rate of Return

The rate of return is printed for each business as a percent, expressing the ratio of the business's net income to its current value. Current value is the original value of the building times its value ratio (or quality index, in the case of a residence) divided by 100, plus the market value of the land consumed by the building.

k. Environmental Indexes

Residences are filled by P1's in the order of lowest environmental indexes first. The characteristics which contribute to a parcel's environmental index are: quality of the school serving the parcel, quality of the MS serving the parcel, residence quality, residence rent, local tax rates, local welfare payments, and the parcel's pollution index. Some of these factors are weighted differently by each class, so there is one index for each class for each parcel. The lower a parcel's environmental index for a class in relation to other parcels' environmental indexes for the class, the more desirable the parcel to migrating population units.

For the exact value of each factor in a parcel's environmental indexes, see the section of the migration output entitled "Environmental Indexes".

10. Basic Industry Detailed Output

The basic industry output shows the location and type of each basic industry owned by a team. A basic industry produces units of output that are sold at national markets and at per unit prices that are determined by the computer-generated national business cycle. Owners of basic industry should consult the section of the Demographic and Economic Statistics that shows the status of the national business cycle.

a. Constructed Level and Operating Level

Of all businesses represented in the model, basic industries alone may decrease their level of operations without demolishing a portion of their buildings. An industry's constructed level is the maximum level at which it may operate. It is effectively a physical restriction on the amount which can be produced. The operating level is the current level at which it is specified to function. The constructed level is considered only when land consumption, maintenance and taxes on the development are calculated. For all other purposes, a business's operating level is the only level considered.

b. Value Ratio and Maintenance Level

The quality of plant and equipment for businesses is represented by the value ratio. The value ratio is the ratio of present value to original value. Business facilities depreciate every year in response to time ("normal" depreciation), MS service quality, adequacy of local water for fire protection, and occasionally, floods. The Economic Master Table shows the annual percent depreciation caused by time, MS quality, and water supply for fire protection. Businesses may overcome this depreciation effect by setting their maintenance levels at points below which they do not want the value ratios to fall. For example, if a maintenance level is set at 100, then that business will make maintenance expenditures every year to keep the building in "like new" shape. The value ratio of a business may be raised above its present value (if less than 100) by inputting a maintenance level that is higher than the value ratio.

c. MS District

The value ratio of basic industry is lowered by poor municipal services as measured by an MS use index in excess of 100. Basic industry output shows the code number of the municipal service unit which serves the basic industry. MS use indexes are shown on the Municipal Services Department

Figure 6.3

```
*******************************************************
    TWOCITY
  ECONOMIC DECISION MAKER A    BASIC INDUSTRY OUTPUT
*******************************************************

      LOCATION                                9632
      CONSTRUCTED LEVEL                       MP 1
      OPERATING LEVEL                         MP 1
      VALUE RATIO                              100
      MAINTENANCE LEVEL                        100
      MS DISTRICT                                0
      UTILITY DISTRICT                           2
      DEPRECIATION (%)
          MS                                   2.9
          FIRE                                 3.3
          FLOOD                                0.0
          WATER QUALITY                        0.0
      WATER CONSUMPTION (MGD)
          NORMAL SOURCE                     225.00
          OUTSIDE                           0.0
      PERCENT WATER RECYCLED                     0
      EFFLUENT TREATMENT
          TYPE AND LEVEL                      ST 1
      SALARY (PER WORKER IN 100'S
          HIGH                                 110
          MIDDLE                                43
          LOW                                   29
      EMPLOYEES
        FULL TIME (IN P1'S)
          HIGH                                  19
          MIDDLE                                18
          LOW                                   18
        PART TIME (IN UNITS)
          HIGH                                  80
          MIDDLE                               160
          LOW                                  320
      EMPLOYMENT EFFECT                       1000
      UNITS PRODUCED                          1000
      PRICE/UNIT OUTPUT                     188300
      INCOME
          SALES(PRIVATE)                 188300000
      EXPENDITURES
          GOODS                           18200000
          SERVICES                         3500000
          MAINTENANCE                     17000000
          UTILITIES                         770000
          WATER
            RECYCLING                            0
            INTAKE PROCESS                17550000
            OUTFLOW TREATMENT                    0
            MUNICIPAL SUPPLY                     0
          TRANSPORTATION                  12037497
          SALARIES                        52920000
          PROPERTY TAXES                   3608800
          SALES TAXES                      1161000
          INCOME TAXES                    22785000
      NET INCOME                          56317703

      RATE OF RETURN                         23.47
```

Report and on the Municipal Services Map. The contribution of the MS use index to value ratio decline is directly proportional to the amount by which the use index exceeds 100. For example, a use index of 150 has double the effect of a use index of 125 and five times the effect of a use index of 110.

d. Utility District

Utility districts provide water and sewer services in addition to other utilities. If a district provides an insufficient amount of water for its users' needs, the fire protection afforded those users is inadequate. That inadequacy is reflected in an increased depreciation for all economic activities in the district. A water shortage can occur for any of the following reasons: 1) the intake water quality is 9 and therefore untreatable; 2) there is insufficient water for all of the users' needs; or 3) the district's intake treatment plant has the capacity to treat less water than its users need.

e. Depreciation

A basic industry has a normal annual depreciation, depending on its type (see Master Tables for depreciation rates). It can also depreciate due to inadequate municipal services and/or inadequate fire protection. Another factor in depreciation is flooding. The director specifies when floods occur and a general degree of flooding. The degree of damage to the economic activity on a particular parcel is influenced by three additional factors: 1) the type of activity; 2) the river basin dam priorities; and 3) the likelihood of the parcel being affected by a flood. This last factor is called the parcel's flood susceptibility and can be found on the River Basin Flood Plain Map. A parcel having zero flood susceptibility is never affected by floods; a parcel having a susceptibility of three is among the most affected parcels. The parameters for the other factors in depreciation can be found on the Master Tables. The amount of depreciation due to MS, fire, and flood is printed in percent of the activity's original value, assumed to be 100%.

Basic industries which use surface water have an additional factor in depreciation: intake water quality. The maximum depreciation due to intake water quality is 1%, for water quality 9. The depreciation decreases as the water quality rating decreases, and there is no depreciation for quality 1 water.

f. Water Consumption and Recycling

Industries that use municipally-supplied water normally receive all of their required water from a local municipal source (the one within their utility district). However, there is one exception: when the utility district provides insufficient water for all of its users' needs. An industry supplied by a municipal water source receives water from Outside only when the local supply is inadequate. When such occurs, each industry receives an amount of water proportionate to its needs. For example if the needs of all of the water users in a utility totaled to 24 MGD and the district was only able to supply 16 MGD (67%), an industry needing 12 MGD would receive 8 MGD from the district (67% of its needs).

The only businesses which do not use municipal water are those basic industries which use surface water directly. There are two cases in which such a business would not obtain all of its water requirement from the surface water: 1) the total amount attempted removed from the surface water by itself and municipal intake points on its parcel was greater than the amount of surface water on the parcel; or 2) the surface water quality was 9. In the first case, the business would receive an amount of the surface water proportionate to its requirement. In the second case, the industry would purchase all of its water requirement from the Outside.

Basic industries which use surface water can recycle up to 100% of their water. At a recycling level of 100% an industry requires half as much water as normal and has half as much effluent, although the amount of pollution in the effluent does not change.

g. Effluent Treatment

A basic industry which uses surface water can treat its effluent. A treatment plant can be one of four types: chlorination (CL), primary treatment (PT), secondary treatment (ST), or tertiary treatment (TT). Each of the four types removes a percent of each pollutant, chlorination removing the least and tertiary the most. A treatment plant has a fixed capacity which is a function of its level. Each level of a business's effluent treatment plant has the capacity to treat the effluent generated by one level of the business at a recycling level of zero. For example, a level two treatment plant can treat all of the effluent generated by a business operating at a level two with no recycling. The plant could handle all of the effluent of a business operating at a level four if it had 100% recycling. Any effluent in excess of treatment plant capacity is dumped untreated into the surface water.

h. Salary

All industries must hire employees in terms of whole population units in order to operate and earn income.

Employees' salaries are expressed in terms of wage per worker and not per P1. Since the number of population units actually hired by an employer is determined by the employment process which takes into account location, transportation, educational level of workers, salary offered and supply of and demand for workers, it is important that employers take into consideration the local labor market situation when setting salary levels.

i. Employees and Employment Effect

The number of population units required for a level one development of all businesses is shown in the Economic Master Table. The number actually hired is shown on the detail business output. Full-time employees are shown in population units (P1's) and part-time employees are shown in time units, where 80 time units is equivalent to a full-time job in terms of income earned for a P1.

If a basic industry hires all of the employees it requires, the employment effect is 1000 per level of development. A value of less than 1000 means that either some of the full or some of the part-time employees required from some income class were not hired. It is useful to check the Employment Summary and the Part-time Employment Statistics if deficiency of employees exists. If a basic industry at level one hires only 80 percent of the P1's it requires, then the employment effect is 800 (i.e., 1000 x .80).

j. Units Produced

The maximum units produced by a basic industry is 1000 per level. If the employment effect is less than 1000 and/or if the value ratio is less than 100 then the units produced will not be at a maximum. The units produced figure is obtained by multiplying the employment effect by the value ratio divided by 100. Thus, if the employment effect were 800 and the value ratio were 90, then the units produced would be 720 (i.e., 800 x .90).

k. Price Per Unit of Output and Income

The price per unit of output for basic industry is determined by the national business cycle price relative and the normal price per unit for the industry type. The actual price per unit of output is the normal price multiplied by the business cycle price relative. Income is the product of the price per unit and the units produced. All sales of basic industry output are to the national system. All output is sold and no inventories are accumulated.

1. Expenditures

Basic industry incurs expenses for business goods and business services. A fixed amount of BG and BS units are purchased by basic industry by type and level for normal operation. Basic industry also purchases BG and BS units in direct proportion to the amount of maintenance performed, and these expenditures are listed separately under the maintenance category.

The expenditure for utilities depends upon the number of utility units consumed by basic industry by type and level (see the Economic Master Table) and price per utility unit being charged by the Utility Department.

There are four types of basic industry expenditures related to water: recycling, intake treatment, outflow treatment, and payment for municipal (or Outside) water. A basic industry which uses municipal water can have only the last of the four expenditures. Local water prices per million gallons consumed in a year are set by the Utility Department for each economic activity. The prices for industries may be set by type. The industry pays the local price for that amount of water which is obtained from the Utility Department and pays the Outside price for the amount not supplied by the Utility Department (see Master Tables for Outside prices).

The pricing is relatively straightforward. For example, suppose an industry consumes 10 MG per day and 2500 MG per year. Suppose the total amount of water required by the water users in its utility district is 24 MGD but the district can supply only 16 MGD (67%). The industry output would show 6.7 MGD obtained from the municipal source and 3.3 MGD from the Outside. The total amount obtained from both sources equals the total daily amount required by the industry (10 MGD).

Whereas the daily requirement is used for determining local water sufficiency, the billing is done on an annual basis in proportion to the amount obtained from each source daily. Suppose the local price per MG for the industry is $300. Let the Outside price, which is always the same for all water users, be $700 per MG. Then the industry's water expenditure for Outside water is: $700 x 3.3 x 250 = $577,500. The proportion purchased daily from Outside is multiplied by the total annual requirement and the Outside cost per MG.

The industry's payment to the local Utility Department is: $300 x 6.7 x 250 = $502,500.

A basic industry which uses surface water can incur all four types of expenditures. Recycling and outflow treatment costs are direct functions of the business owner's decisions. The owner can set a recycling level of 0 to 100. A business at 100% recycling requires half as much water as a business at recycling level zero. Likewise, it has half as much effluent. The cost to recycle a million gallons of water is given on the Master Table. Suppose a TA required 17 MGD and 4420 MGY for a level one without recycling. Suppose a TA2 has a recycle level of 60%, and the cost to recycle is $200 per million gallons. The TA's annual volume of recycling would be: 4420 MGD x 2 x (100-60)/200 = 1768 MG. The cost for recycling would be: $200/MG x 1768 MG = $353,600.

The business owner also decides what type and level of effluent treatment, if any, the business has. The operating cost of an effluent treatment plant varies by type of treatment and number of MG's treated in a year. Suppose the TA cited above had an ST1 effluent treatment plant and the treatment cost per MG for ST was $200. Since the ST1 can treat only the equivalent of the outflow from a level one business, its capacity would be 4420 MG in a year. The business has 7072 MG of effluent (4420 x 2 - 1768). It pays $200 x 4420, or $884,000 for effluent treatment. 2652 MG are dumped untreated.

Expenditures for intake treatment and Outside water (listed under MUNICIPAL SUPPLY) are automatically billed to the business. A business does not construct an intake treatment plant; it is assumed to treat all of its required water to a usable condition. Intake treatment costs are a function of the intake water quality, the type of business, the volume of water consumed. If the intake water quality of the TA cited above were 3, and if the cost to a TA to treat water quality 3 were $80 per MG, the TA's intake treatment cost would be: (4420 MG x 2 - 1768 MG) x $80/MG = $565,760.

There is no cost to treat water purchased from the Outside. If part of a business's water were obtained from the surface water and, due to a shortage of surface water, part were obtained from the Outside, then the business would have expenditures for both intake treatment and Outside supply. If the surface water quality were 9, the business would have only the latter expenditure.

Basic industry pays transportation to BG and BS if the industry purchases these from the local system. The transportation charges are based on the type and level of industry and the least cost distances along the various types of roads. All basic industries except NS also incur transportation costs to the terminal which represents the cost of shipping the units produced to national markets. The transportation costs to BG, BS and the terminal are independent of the number of units purchased or produced. The costs are solely a function of type of industry, level, distance travelled to destination and type of roads. Regardless of the distance travelled, an industry pays a base cost to travel to each of the three types of destinations. The total transportation cost (c) to a single destination is:

$C = (U \times B) + [U \times B \times L \times (4 \times T - R)]$
where U is the number of units consumed
and B is the base cost per unit consumed
and L is the length of a parcel side in miles
and T is the number of parcel sides traversed along the least cost route between origin and destination
and R is the sum of the road types traversed along parcel sides on the least cost route
U x B is the base cost which the industry must pay.

Suppose that the Master Table showed that a CR1 consumes 3000 terminal units and has a base cost of $500 per terminal unit consumed. Suppose also that there is only one terminal and a CR2 has no options on ways to travel: it must go four parcels on a type 2 road and two parcels on a type 3 road. Suppose that in the simulated region a parcel side is 2.5 miles long.

U = 3000 times 2, or 6000 terminal units consumed
B = $500
L = 2.5
T = 6, since six parcels are traversed
R = 14, for four parcels on type 2 and two parcels on type 3 (4 x 2 + 2 x 3 = 14)

The total transportation cost to terminal for the CR is:

6000 x \$500 + 6000 x \$500 x 2.5 x (4 x 6 - 14) =
\$3,000,000 + \$75,000,000 = \$78,000,000

Salary costs by class are determined by multiplying the salary per worker times the number of workers per P1 times the number of P1's hired.

Businesses pay property tax on the assessed value of the development and the land occupied by the development. The Assessment Department assesses the value of land and developments and the Chairman and Council determine the tax rates to be applied to the assessed values of developments and of land.

Businesses pay income taxes to the Federal and State governments using the rates shown in the Master Table.

Businesses pay sales taxes on the purchases from BG and BS. There is a fixed state sales tax of 3%. State sales taxes are paid on purchases from the Outside system as well as on local purchases.

m. Net Income and Rate of Return

Basic industry net income is obtained by subtracting all of the above expenditures from the gross income.

The rate of return is printed for each business as a percent, expressing the ratio of the business's net income to its current value. Current value is the original value of the building times its value ratio divided by 100, plus the market value of the land consumed by the building.

11. Commercial Establishment Detailed Output

The computer output for commercial establishments is slightly different for business commercial (BG and BS) and for personal commercial (PG and PS). The major difference is that BG and BS always purchase their needed supplies from the outside system, whereas PG and PS are able to purchase their goods and services from local BG and BS establishments. The commercial output shows the location, type and level of development.

a. Value Ratio and Maintenance Level

The quality of plant and equipment for commercial establishments is represented by the value ratio. The value ratio is the ratio of present value to original value. Commercial establishments depreciate every year in response to time ("normal" depreciation), MS service quality, use by customers, adequacy of local water for fire protection, and occasionally floods. The Commercial Master Table shows the annual percent depreciation caused by time, MS quality, use, and water supply for fire protection. Businesses may overcome this depreciation effect by setting their maintenance levels at points below which they do not want the value ratios to fall. For example, if a maintenance level is set at 100, then that business will make maintenance expenditures every year to keep the building in "like new" shape. The value ratio of a business may be raised above its present value (if less than 100) by inputting a maintenance level that is higher than the value ratio.

b. MS District

The value ratio for commercial establishments is lowered by poor municipal services as measured by an MS use index in excess of 100. The computer output for commercial establishments shows the code number of the municipal service unit which serves the basic industry. MS use indexes are shown on the Municipal Services Department Report and on the Municipal Services Map. The contribution of the MS use index to value ratio decline is directly proportional to the amount by which the use index exceeds 100. For example, a use index of 150 has double the effect of a use index of 125 and five times the effect of a use index of 110.

c. Utility District

Utility districts provide water and sewer services in addition to other utilities. If a district provides an insufficient amount of water for its users' needs, the fire protection afforded those users is inadequate. That

Figure 6.4

```
**********************************************************************
    TWOCITY
  ECONOMIC DECISION MAKER F    COMMERCIAL OUTPUT              ROUND  2
**********************************************************************
              LOCATION                               9230
              TYPE AND LEVEL                         PG 1
              VALUE RATIO                              90
              MAINTENANCE LEVEL                        90
              MS DISTRICT                               1
              UTILITY DISTRICT                          1
              DEPRECIATION (%)
                  MS                                  2.6
                  FIRE                                0.0
                  FLOOD                               0.0
                  USE                                 0.8
              WATER CONSUMPTION (MGD)
                  MUNICIPAL                          0.23
                  OUTSIDE                            0.0
              SALARY (PER WORKER IN 100'S)
                  HIGH                                100
                  MIDDLE                               50
                  LOW                                  25
              EMPLOYEES
                FULL TIME (IN P1'S)
                  HIGH                                  8
                  MIDDLE                               13
                  LOW                                  18
                PART TIME (IN UNITS)
                  HIGH                                  0
                  MIDDLE                               80
                  LOW                                 160
              EMPLOYMENT EFFECT                     14609
              CAPACITY USED                         13822
              EFFECTIVE CAPACITY                    13148
              PRICE/CU                              10000


              INCOME
                  SALES(PRIVATE)                138220000


              EXPENDITURES
                  GOODS                          66430000
                  SERVICES                       23500000
                  MAINTENANCE                     1800000
                  UTILITIES                        960300
                  WATER                             32085
                  TRANSPORTATION                   720000
                  SALARIES                       30800000
                  PROPERTY TAXES                  1022508
                  SALES TAXES                     2751900
                  INCOME TAXES                    2738750
              NET INCOME                          7496542

              RATE OF RETURN                        27.76
```

inadequacy is reflected in an increased depreciation for all economic activities in the district. A water shortage can occur for any of the following reasons: 1) the intake water quality is 9 and therefore untreatable; 2) there is insufficient water for all of the users' needs; or 3) the district's intake treatment plant has the capacity to treat less water than its users need.

d. Depreciation

A commercial establishment has a normal annual depreciation, depending on its type (see Master Tables for depreciation rates). It can also depreciate due to inadequate municipal services, use in excess of its effective capacity, and/or inadequate fire protection. Another factor in depreciation is flooding. The director specifies when floods occur and a general degree of flooding. The degree of damage to the economic activity on a particular parcel is influenced by three additional factors: 1) the type of activity; 2) the river basin dam priorities; and 3) the likelihood of the parcel being affected by a flood. This last factor is called the parcel's flood susceptibility and can be found on the River Basin Flood Plain Map. A parcel having zero flood susceptibility is never affected by floods; a parcel having a susceptibility of three is among the most affected parcels. The parameters for the other factors in depreciation for commercial establishments can be found on the Commercial Master Tables. The amount of depreciation due to MS, fire, flood, and use is printed in percent of the activity's original value, assumed to be 100%.

e. Water Consumption

Commercial establishments use municipally-supplied water and they normally receive all of their required water from a local municipal source (the one within their utility district). However, there is one exception: when the utility district provides insufficient water for all of its users' needs. A commercial establishment supplied by a municipal water source receives water from Outside only when the local supply is inadequate. When such occurs, each business receives an amount of water proportionate to its needs. For example if the needs of all of the water users in a utility totaled to 24 MGD and the district was only able to supply 16 MGD (67%), a business needing 3 MGD would receive 2 MGD from the district (67% of its needs).

f. Salary

All businesses must hire employees in terms of whole population units in order to operate and produce shopping capacity. Employees' salaries are expressed in terms of wage per worker and not per P1. Since the number of population units actually hired by an employer is determined by the employment process which takes into account location, transportation, educational level of workers, salary offered and supply of and demand for workers, it is important that employers take into consideration the local labor market situation when setting salary levels.

g. Employees and Employment Effect

The number of population units required for a level one development of all commercial establishments is shown in the Commercial Master Table. The number actually hired by a commercial establishment is shown on the detailed computer output. Full-time employees are shown in population units (P1's) and part-time employees are shown in time units, where 80 time units is equivalent to a full-time job in terms of income earned for a P1.

If a commercial establishment hires all of the employees it requires, the employment effect is equal to the design capacity shown in the Commercial Master Table. A value of less than this design capacity means that either some of the full or some of the part-time employees required from some income class were not hired. It is useful to check the Employment Summary and the Part-time Employment Statistics if deficiency of employees exists. If a commercial establishment at a development level of one hires only 80 percent of the P1's it requires, then the employment effect is 80 percent of the design capacity.

h. Capacity Used and Effective Capacity

The effective capacity is calculated for commercial establishments by multiplying the employment effect times the value ratio divided by 100. The effective capacity indicates the number of capacity units (CU's) that the commercial establishment can supply to its customers without a strain on plant, equipment, and quality of service.

Capacity used is the number of consumption units that the commercial establishment actually sold to customers in the competitive local market as determined by the commercial assignment process. If the capacity used exceeds the effective capacity, then the commercial establishment undergoes a strain on its plant and equipment that is represented by increased depreciation of the physical facilities. BG and BS establishments may sign contracts with local government departments (Schools and Municipal Services) to automatically supply these departments with their needed goods and services. If these two government departments do not make a contract with a local firm, they will purchase from the outside system at greater than normal prices per unit. These government departments can specify a contract with up to three local BG and three local BS establishments. Greater detail on these contracts is given under the description of the government sector.

i. Price per Capacity Unit (CU)

Each commercial establishment sets its own price. Factors that must be taken into account when setting price are location in relation to potential workers, buyers and sellers; competitive establishments; local demand; boycotts; and the typical price. Typical prices are listed in the Economic Master Table.

The Commercial Process assigns customers to commercial establishments on the basis of least cost to the customer per consumption unit, including the customer's transportation cost to get to the commercial establishment. Customers also are given a bias to shop where they shopped the previous year and a bias against shopping at over-crowded establishments.

Owners of commercial establishments are encouraged to examine the commercial allocation summary output and the commercial maps to see which stores are serving which customers. A detailed description of this output can be found under the General Output Section.

j. Income

Sales to private customers and sales to public customers are separated for BG and BS, but not for PG and PS since the latter establishments sell to only the private sector. Income is the product of capacity used and price per CU.

k. Expenditures

BG and BS spend money for service charges which represent purchases from the outside system. PG and PS spend money for business goods and business services that represent the finished goods and services that they require in order to operate. In both cases, the dollar amount of expenditures for goods and services (service charges) is directly related to the number of capacity units sold. These relationships are shown in the Commercial Master Table.

Commercial establishments must pay annual maintenance if the value ratio is to be prevented from declining. BG and BS pay their maintenance to the outside system, whereas PG and PS purchase units of BG and BS for the purposes of maintenance. These relationships are also shown in the Commercial Master Table along with the factors that cause depreciation. Remember that overcrowding of commercial establishments causes the depreciation rate to increase.

Commercial establishments purchase utilities based upon type and level of development as indicated in the Commercial Master Table.

There is one type of commercial establishment expenditure for water: payment for municipal (or Outside) water. Local water prices per million gallons consumed in a year are set by the Utility Department for each economic activity. The prices for commercial establishments may be set by type of establishment. The business pays the local price for that amount of water which is obtained from the Utility Department and pays the Outside price for the amount not supplied by the Utility Department (see Outside System Master Tables for Outside prices).

The pricing is relatively straightforward. For example, suppose a business consumes 1.0 MG per day and 300 MG per year. Suppose the total amount of water required by the water users in its utility district is 24 MGD but the district can supply only 16 MGD (67%). The business output would show .67 MGD obtained from the municipal source and .33 MGD from the Outside. The total amount obtained from both sources equals the total daily amount required by the industry (1.0 MGD).

Whereas the daily requirement is used for determining local water sufficiency, the billing is done on an annual basis in proportion to the amount obtained from each source daily. Suppose the local price per MG for the commercial establishment is $300. Let the Outside price, which is always the same for all water users, be $700 per MG. Then the business's water expenditure for Outside water is: $700 x .33 x 300 = $70,000. The proportion purchased daily from Outside is multiplied by the total annual requirement and the Outside cost per MG. The business's payment to the local Utility Department is: $300 x .67 x 300 = $60,000.

PG and PS have transportation charges to BG and BS if they purchase locally, BG has transportation to terminal to purchase goods from the Outside system, and BS has no transportation charges. The transportation costs by type of road to the several destinations are given in the

Commercial Master Table. Transportation costs incurred by commercial businesses are dependent upon the number of units purchased. The costs are also dependent upon the type of buyer and seller, the distance travelled to the destination, and the type of roads. Regardless of the distance travelled, a business pays a base cost to travel to a destination. The total transportation cost (c) to a single destination is:

$$C = (U \times B) + [U \times B \times L \times (4 \times T - R)]$$

where U is the number of units consumed
and B is the base cost per unit consumed
and L is the length of a parcel side in miles
and T is the number of parcel sides traversed along the least cost route between origin and destination
and R is the sum of the road types traversed along parcel sides on the least cost route
$U \times B$ is the base cost which the business must pay.

Suppose that the commercial output showed that a BG 1 had a capacity used of 2000 and therefore consumed 2000 terminal units. Assume that the Commercial Master Table shows that it cost $400 per HY 3 mile to travel to the terminal. Suppose also that there is only one terminal and the BG 2 has no options on ways to travel: it must go four parcels on a type 2 road and two parcels on a type 3 road. Suppose that in the simulated region a parcel side is 2.5 miles long.

$U = 2000$ terminal units consumed
$B = \$400$
$L = 2.5$
$T = 6$, since six parcels are traversed
$R = 14$, for four parcels on type 2 and two parcels on type 3 $(4 \times 2 + 2 \times 3 = 14)$

The total transportation cost to terminal for the BG is:

$$2000 \times \$400 + 2000 \times \$400 \times 2.5 \times (4 \times 6 - 14) = \$800{,}000 + 20{,}000{,}000 = \$20{,}800{,}000$$

Salary costs by class are determined by multiplying the salary per worker times the number of workers per P1 times the number of P1's hired.

Businesses pay property tax on the assessed value of the development and the land occupied by the development. The Assessment Department assesses the value of land and developments and the Chairman and Council determine the tax rates to be applied to the assessed values of developments and of land. Businesses pay income taxes to the

Federal and State governments using the rates shown in the Commercial Master Table. State income taxes apply to the net income figure before other taxes have been deducted.

Businesses pay sales taxes on the purchases of goods and services. There is a fixed state sales tax of 3%. State sales taxes are paid on purchases from the Outside system as well as on local purchases.

1. Net Income and Rate of Return

Business net income is obtained by subtracting all of the above expenditures from the gross income. Net income for commercial establishments can be very volatile because of the competitive aspect of the local market and the individual business's control over pricing.

The rate of return is printed for each business as a percent, expressing the ratio of the business's net income to its current value. Current value is the original value of the building times its value ratio divided by 100, plus the market value of the land consumed by the building.

IV. Economic Sector Decisions

A. Summary of Decisions

The decisions that are available to the Economic-Sector decision-makers may be classified into three categories: those specific to a team, those specific to a particular business, and capital expenses. These are outlined below.

- Decisions Specific to a Team
  - Lend Money (to other teams)
  - Borrow Money (from outside bankers)
  - Invest or Disinvest in Stocks (outside system)
  - Transfer Cash (to social or economic teams or government department)

- Decisions Specific to a Business
  - All Businesses
    - Change Maintenance Level
    - Boycott
  - Residences
    - Change Rents
  - Commercial
    - Change Prices
  - Commercial and Industrial
    - Change Salaries
  - Industrial
    - Change Operating Level
    - Construct or Demolish Effluent Treatment Plant
    - Recycle Water Used
  - Farms
    - Change Fertilizer Level Used

- Capital Decisions
  - Purchase Land
  - Construct or Demolish Land Use Activities

B. Input Format

Local system decision-makers (such as the Economic Sector) use a standardized input form (Figure ES-2) when making decisions that must be processed by the computer.

The standard format for these decisions is:

```
$CODE/=dm/a, b, c, ...
```

1. $CODE stands for the type of decision code. The Economic Sector has the option to make decisions that use the following decision codes:

$OTHER	(lend and borrow money, invest in or sell stocks)
$CASH	(transfer cash)
$CVPT	(change rents, prices, maintenance levels, salaries)
$BYCT	(boycott)
$ENDS	(change a business's operating or recycling level)
$WRBLD	(construct or demolish an effluent treatment plant)
$ODDS	(change a farm's fertilizer level)
$PU	(buy or sell land)
$BUILD	(construct or demolish an economic activity)

2. "=dm" is the decision-maker, which for the economic sector is "A", "B", "C", etc.

3. The columns "a", "b", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

Figure ES-2

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER BASIN MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$______ /	=______ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____

ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e
DECISIONS SPECIFIC TO A TEAM							
LEND MONEY	$OTHER	A, B, C, etc.	LO	amount (in $10,000's)	term (2 or 25)	interest rate (in mils)	borrower
BORROW MONEY	$OTHER	A, B, C, etc.	BO	amount (in $10,000's)	term (2 or 25)		
INVEST OR DISINVEST IN STOCKS	$OTHER	A, B, C, etc.	SP, CN, SELLSP, SELLCN	amount (in dollars)			
TRANSFER CASH	$CASH	A, B, C, etc. NOTE: IF SOCIAL RECIPIENT put 0 in column "f" and location in column "g".	C	receiver (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	PVT	if recipient is: economic, PVT; social, H, M,or L; government, CAPital or CURrent account

ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e
ALL BUSINESSES							
CHANGE MAINTENANCE LEVEL	$CVPT	A, B, C, etc.	M	location	new maintenance level		
BOYCOTT	$BYCT	A, B, C, etc.	E	land use boycotting	S	location boycotted	Stop the Boycott or Begin it
RESIDENCES ONLY							
Change Rents	$CVPT	A, B, C, etc.	R	location	new rent per space unit (in $1000's)		
COMMERCIAL ONLY							
Change Prices	$CVPT	A, B, C, etc.	P	location	price/CU (in $100's)		
COMMERCIAL AND INDUSTRIAL							
Change Salaries	$CVPT	A, B, C, etc.	S	location	salary to low income (specified as salary per worker in $100's)	salary to middle income (specified as salary per worker in $100's)	salary to high income (specified as salary per worker in $100's)

ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g
INDUSTRIAL ONLY									
Change the Operating Level	$ENDS	A, B, C, etc.	L	location	New Level	Old Level	New Level	0	New Treatment Type (CL,PT, ST,TT)
Construct or Demolish Effluent Treatment Plant	$WRBLD	A, B, C, etc.	T	location	OUT	Old Level	New Level	0	New Treatment Type (CL,PT, ST,TT)
Recycle Water Used	$ENDS	A, B, C, etc.	R	location	percent recycling (0 to 100)				
FARMS ONLY									
Change the Fertilizer Level	$ODDS	A, B, C, etc.	F	farm code number	fertilizer level (0-3)				

ECONOMIC DECISION-MAKERS: INPUT EXPLANATION FORM

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g	h	i
CAPITAL DECISION											
Purchase or bid on land	$PU	A, B, C, etc.	location	price (in $1000's)	seller (economic team, or department and jurisdiction or, if bid, OU)	if from department, percent of parcel					
Construct or Demolish Land Use Activities	$OUBLD	A, B, C, etc.	location	land use code	old level	new level	maintenance level	*	*	*	*

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*f if residence, quality index; if business, salary to PL, worker (in $100's)
*g if residence, 0 or 1 (if private utilities); if business, salary to PM worker (in $100's)
*h if residence, rent per space unit (in $1000's); if business, salary to PH workers (in $100's)
*i if commercial, price per CU (in $100's)

C. Sample Decisions

A. Decisions Specific to a Team

A.1 Lend Money

Team A lends team C $2,000,000 for a period of 2 rounds and at an annual interest rate of 8.5 percent.

Team F lends team G $150,000 for a period of 25 years at an annual interest rate of 10.7 percent.

A.2 Borrow Money

Team B places an application with outside system bankers to borrow $14,000,000 to be paid off during a 25 year period. (This decision will be accepted if this loan does not make Team B's debts rise above 80 percent of its net worth.)

A.3 Invest or Disinvest in Stocks

Team A invests $159,000 in speculative stocks.
Team B invests $42,550 in conservative stocks.
Team C disinvests (sells) $452,753 worth of speculative stocks.
Team D sells $35,000 worth of conservative stocks.

A.4 Transfer Cash

Team E transfers $25,000 in cash to Team F.
Team E transfers $10,000 in cash to the low-income social living on parcel 9230 and controlled by social decision-maker GG. (Note that social teams are identified for this by a two lettered name.)
Team E transfers $2,700,000 to the capital account of the School Department in Jurisdiction 1.

B. Decisions Specific to a Business
All Businesses

B.1 Change Maintenance Level

Team A changes the maintenance level for its FA3 on 9248 from 80 to 85.

Team B changes the maintenance level for its BG on 9632 and for its NS on 10032 to 92. (Note that all the parcel numbers within the parentheses are treated as a single list of information.)

B.2 Boycott

Team B has its RA housing boycott the PG establishment at 9232 owned by Team C.

Team D stops the boycotts that its chemical establishment (CR) had against the BG at 10018.

Residences

B.3 Change Rents

Team D changes the rent for its RB5 on 11232 from $135,000 per space unit to 147,000 per space unit.

Commercial

B.4 Change Prices

Team G changes the price per unit of output sold for its PS at 11438 from $10,000 to $11,500.

Commercial and Industrial

B.5 Change Salaries

Team F changes the low-income salaries paid at the BS on parcel 10040 from $2,500 per worker to $2,700 per worker. He leaves the PM salary at $5,000 and the PH salary at $10,000. (Note that the old salaries must be listed on the input form for those income classes whose salaries were not changed.)

Industrial

B.6 Change Operating Level

Team C wishes to reduce the operating level of its CR3 at 10844 from 3 to 2 and increase the operating level of its MP (which has a constructed level of 3 but a present operating level of 1) at 11040 from a 1 to 2.

B.7 Construct Effluent Treatment Facilities

Team A decides to construct a second level primary treatment facility for its PA3 at 10838.

Team F decides to demolish one of the levels of its third level tertiary treatment facility on parcel 9842.

B.8 Recycle Water Used

Team G decides to recycle 50 percent of the water used by its MP2 at location 8430.

Farms

B.9 Change the Fertilizer Level Used

Team A decides to change the fertilizer level of its farm (code number 2) from 2 to 0.

C. Capital Decisions

C.1 Purchase or Sell Land

Team A places a bid for $1,000,000 on parcel 11448 which is owned by the outside system. (The director will determine if this bid is successful. Successful or not Team A will pay a bid fee just to make the bid. The amount of the bid fee is listed in the Economic Master Table and it is expressed as a percent of the bid price.)

Team A purchases all of the privately owned land (and any developments that happen to be on this land) from Team B for $5,600,000.

Team A purchases 36 percent of parcel 9242 from the Planning and Zoning Department in Jurisdiction 1 for $1,430,000. This land may be used immediately by Team A for any use allowed to Team A.

C.2 Construct or Demolish Land Use Activities

Team A demolishes an RA5 that was located on 11238. (Assume that Team A also gets the government to rezone the land and supply the needed level of utility service.) Team A then constructs a CR1 on the cleared land. The maintenance level for this CR1 is specified to be 100 and the salaries offered are $3,700 for PL workers, $5,400 for PM workers, and $10,500 for PH workers.

Team B upgrades (builds more on a parcel that already has some development) the RB2 on parcel 10034 to an RB3 and sets the new maintenance level at 80. The quality index for the new level of housing is 80 (this is averaged with the old quality of the RB2 already there) and the new rent for the entire RB3 is $150,000 per space unit.

Team C upgrades the BG1 at 9434 to a BG2 and sets the new maintenance level to 70. Salaries are specified as $2,800 per PL worker, $5,200 per PM worker, and $10,600 per PH worker. The price charged for units sold by the BG is set at $107,000 per CU (capacity unit).

SAMPLE DECISION INPUTS FOR THE ECONOMIC SECTOR

Sample Decision	Decision Code	Decision-Maker	a	b	c	d	e	f	g
A.1	$ OTHER /	= A /	L0,	200,	2,	85,	C		
A.1	$ OTHER /	= F /	L0,	15,	25,	107,	G		
A.2	$ OTHER /	= B /	B0,	1400,	25				
A.3	$ OTHER /	= A /	SP,	159000,					
A.3	$ OTHER /	= B /	CN,	42550,					
A.3	$ OTHER /	= C /	SELLSP,	452753					
A.3	$ OTHER /	= D /	SELLCN,	35000,					
A.4	$ CASH /	= E /	C,	F,	25000,	PVT,	PVT		
A.4	$ CASH /	= E /	C,	G,	10000,	PVT,	L,	0,	9230
A.4	$ CASH /	= E /	C,	SC1,	2700000,	PVT,	CAP		

SAMPLE DECISION INPUTS FOR THE ECONOMIC SECTOR

Sample Decision	Decision Code	Decision-Maker	a	b	c	d	e	f	g
B.1	$CVPT /	= A /	M	9248	85				
B.1	$CVPT /	= B /	M	(9632, 10032)	92				
B.2	$BYCT /	= B' /	E	RA	S	9232	B		
B.2	$BYCT /	= D /	E	CR	S	10018	S		
B.3	$CVPT /	= D /	R	11232	147				
B.4	$CVPT /	= G /	P	11438	115				
B.5	$CVPT /	= F /	S	10040	27	50	100		
B.6	$ENDS /	= C /	L	10844	2				
B.6	$ENDS /	= C /	L	11040	2				
B.7	$WRBLD /	= A /	T	10838	OUT	0	2	0	PT
B.7	$WRBLD /	= F /	T	9842	OUT	3	2	0	TT
B.8	$ENDS /	= G /	R	8430	50				
B.9	$ODDS /	= A /	F	2	0				

SAMPLE DECISION INPUTS FOR THE ECONOMIC SECTOR

Sample Decision	Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i
C.1	$ PU /	= A /	11448,	1000,	0U,	,	,	,	,	,	,
C.1	$ PU /	= A /	11038,	5600,	B,	,	,	,	,	,	,
C.1	$ PU /	= A /	9242,	1430,	PZ1,	36,	,	,	,	,	,
	$ /	= /	,	,	,	,	,	,	,	,	,
C.2	$ 0UBLD /	= A /	11238,	RA,	5,	0,	,	,	,	,	,
C.2	$ 0UBLD /	= A /	11238,	CR,	0,	1,	100,	27,	54,	105,	,
C.2	$ 0UBLD /	= B /	10034,	RB,	2,	3,	80,	80,	0,	150,	,
C.2	$ 0UBLD /	= C /	9434,	BG,	1,	2,	70,	28,	52,	106,	1070,

V. Economic Sector Master Tables

The numerical values of direct importance to the economic decision-makers are found in six master tables:

A. Master Table for Economic Teams (showing information on borrowing and debts, rates of return on stocks, normal price relatives for basic industries, development alternatives, boycotts, and taxes)

B. Master Table for Industrial Establishments (showing information for all the basic industries including NS)

C. Master Table for Commercial Establishments (showing information for BG, BS, PG, and PS)

D. Master Table for Residences (showing information for RA, RB, and RC type housing)

E. Farm Master Table (showing changes in income as a function of the fertilizer level and the pollution associated with the various fertilizer levels for each of five farm types)

F. Planning Master Table (showing the impact of the industrial, commercial, and residential developments on land consumption, utility service, employment, terminal usage, and municipal services)

A. MASTER TABLE FOR ECONOMIC TEAMS

LIMITATIONS ON DEBTS	
MAXIMUM AMOUNT OF DEBT	80% OF NET WORTH
NORMAL RANGE OF OUTSIDE INTEREST RATES	4.3% to 6.2%
NORMAL RANGE OF RATES OF RETURN ON	
SPECULATIVE STOCK	- 1 to 10%
CONSERVATIVE STOCKS	5 to 7%
NORMAL RANGE OF PRICE RELATIVES	
HEAVY INDUSTRIES	.90 to 1.12
LIGHT INDUSTRIES	.93 to 1.10
NATIONAL SERVICES	.95 to 1.06

DEVELOPMENTS (LEVEL ONE)	RANGE FOR CONSTRUCTION COSTS (Millions of Dollars)	RANGE FOR LAND REQUIREMENT (Percent of a Parcel)
HEAVY INDUSTRY		
SURFACE WATER USERS	240-300	28-48
MUNICIPAL WATER USERS	140-320	12-40
LIGHT INDUSTRY		
SURFACE WATER USER	120-250	6-28
NATIONAL SERVICES	50	12
LOCAL COMMERCIAL	20-45	10-12
RESIDENCES(100 Quality Index)	1-25	2

Economic Boycotts*

Possible Boycotting Activities	Activities that Can Be Boycotted
FL, SG, MP, MF, NL, EL, TE, FO, TA, PA, CR	
NS, PG, PS	BG, BS
RA, RB, RC	PB, PS

*This does not include any social boycotts that might be directed against economic teams. For example, population units may boycott working at any economic employment location or shopping at any PG or PS establishment.

ECONOMIC TEAMS

Outside System Taxes on all Developments

Income Taxes

State - 5% of gross income minus all expenses except water, utilities, transportation, this tax and federal income tax

Federal - 22% of first $25,000 and 48% of above $25,000 on gross income minus all expenditures except water, utilities, transportation, and this tax

Sales Taxes

3% State sales tax applied against purchases of goods and services (from BG, BS, PG and PS, and purchases from the Outside by BG and BS)

B. MASTER TABLE FOR INDUSTRIAL ESTABLISHMENTS
(LEVEL ONE CHARACTERISTICS)

		FL	SG	MP	MF	NL	EL	TE	FO	TA	PA	CR	NS
	LOCATION REQUIREMENTS												
1.	PERCENT OF PARCEL	28	40	48	20	15	12	12	20	6	16	28	12
	(Maximum Possible Levels)	(3)	(2)	(2)	(5)	(6)	(8)	(8)	(5)	(16)	(6)	(3)	(8)
2.	ZONING REQUIRED	--	--	--	--	--	--	--	--	--	--	--	--
		00	00	00	00	00	00	00	00	00	00	00	00
		10	10	10	10	10	10	10	10	10	10	10	10
		20	20	20	20	20	20	20	20	20	20	20	30
		21	21	21	21	21	21	21	22	22	22	22	31
3.	MINIMUM LEVEL OF UTILITY SERVICE	1	1	7	1	1	2	2	3	1	3	4	1
4.	ANNUAL UTILITY UNITS CONSUMED	50	100	700	100	100	200	200	300	100	300	400	76
5.	CONSTRUCTION COSTS (Millions of Dollars)	300	240	240	320	150	140	180	230	120	250	250	50
	DEPRECIATION												
6.	ANNUAL PERCENTAGE (Due to Aging)	3.0	2.0	4.0	3.5	3.0	4.0	5.0	2.0	1.5	1.5	3.0	3.0
7.	MS EFFECT (Maximum Percentage)	3.0	2.0	4.0	3.0	3.0	4.0	5.0	2.0	2.0	2.0	3.0	3.0
8.	FIRE (Maximum Percentage)	3.0	2.0	4.0	3.5	3.0	4.0	5.0	2.0	1.5	1.5	3.0	3.0
9.	FLOOD	Depends upon amount input by director and location in flood plain											
	FLOOD MULTIPLIER	.6	.6	.6	.6	.6	.6	.6	.5	.5	.5	.5	
10.	WATER QUALITY (Maximum)	1.0	NA	1.0	NA	NA	NA	NA	1.0	1.0	1.0	1.0	
	WATER CHARACTERISTICS												
11.	SURFACE WATER USER	x		x					x	x	x	x	
12	CONSUMPTION (MGD)	61	10	225	9	12	5	8	49	17	333	31	.18
13.	DAYS IN OPERATION PER YEAR	260	260	260	260	260	260	260	260	260	260	260	260
14.	CONSUMPTION (MGY)	15860	2600	58500	2340	3120	1300	2080	12740	4420	86580	8060	46.8
15.	RECYCLING COST PER MG	200	NA	200	NA	NA	NA	NA	200	200	200	200	NA
	MAXIMUM PERCENT OF WATER ABLE TO BE RECYCLED	100	NA	100	NA	NA	NA	NA	100	100	100	100	NA
16.	EFFLUENT TREATMENT CONSTRUCTION COST PER LEVEL (Millions of Dollars)												
	CL	.5	NA	.8	NA	NA	NA	NA	.45	.2	1	.3	NA
	PT	5	NA	8	NA	NA	NA	NA	4.5	2	10	3	NA
	ST	15	NA	24	NA	NA	NA	NA	13.5	6	30	9	NA
	TT	45	NA	72	NA	NA	NA	NA	40.5	18	90	27	NA
	EMPLOYEES												
17.	FULL TIME POPULATION UNITS (P1's)												
	PH	8	14	19	24	21	30	25	15	15	23	24	23
	PM	8	18	18	18	20	18	22	19	10	17	24	9
	PL	35	23	18	17	18	17	15	24	30	20	14	9
18.	PART TIME (Leisure Time Units)												
	PH	0	80	80	80	80	80	80	0	0	80	80	80
	PM	80	160	160	160	80	80	80	80	0	0	80	0
	PL	240	160	320	160	160	80	80	80	240	160	80	0
	CAPACITY MEASURES												
19.	MAXIMUM EMPLOYMENT EFFECT	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
20.	MAXIMUM UNITS PRODUCED	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

	FL	SG	MP	MF	NL	EL	TE	FO	TA	PA	CR	NS
INCOME FACTORS												
21. NORMAL PRICE PER UNIT SOLD (Thousands of Dollars)	196	155	176	232	147	200	184	148	100	183	185	110
22. TYPICAL INCOME FROM SALES (Millions of Dollars)	196	155	176	232	147	200	184	148	100	183	185	110
EXPENDITURES												
23. BUSINESS GOODS (Units)	400	200	140	300	100	400	200	30	20	100	150	60
24. BUSINESS SERVICES (Units)	120	40	35	180	54	246	174	10	10	44	50	23
25. PURCHASES PER 1% MAINTENANCE												
BG UNITS	10	8	10	8	8	6	10	5	4	4	4	1
BS UNITS	2	1	4	4	4	4	6	2	2	2	5	4
26. TYPICAL UTILITIES COSTS (Millions of Dollars)	.5	1.0	7.0	1.0	1.0	2.0	2.0	3.0	1.0	3.0	4.0	.76
27. WATER (Millions of Dollars)												
RECYCLING (Assuming 100% recycled)	3.17	NA	11.70	NA	NA	NA	NA	2.55	.88	17.32	1.61	NA
INTAKE PROCESS (Assuming Water Quality of 4)	1.59	NA	5.85	NA	NA	NA	NA	1.27	.44	8.66	.81	NA
OUTFLOW TREATMENT (Operating Costs)												
CL ($1000)	397	NA	1463	NA	NA	NA	NA	319	111	2165	302	NA
PT	1588	NA	5852	NA	NA	NA	NA	1276	444	8660	808	NA
ST	3176	NA	11704	NA	NA	NA	NA	2552	888	17320	1616	NA
TT	4764	NA	17556	NA	NA	NA	NA	3828	1332	25980	2424	NA
MUNICIPAL SUPPLY (Assuming water costs of $450 per MG) (Millions of Dollars)	NA	1.17	NA	1.05	1.40	.59	.94	NA	NA	NA	NA	.02
28. TRANSPORTATION (Per Unit of Output on Type 3 Road)												
TO BG	2500	6000	7000	2700	7000	1000	2500	1000	5000	2000	2000	1250
TO BS	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1250
TO TERMINAL	2500	2000	2000	1500	1000	500	1500	1000	500	1500	1000	NA
TERMINAL UNITS	1000	10000	6000	2000	1000	1000	2000	3000	1000	3000	3000	NA
29. SALARIES (Full Employment)	Depends upon Salary levels offered.											
30. TAXES												
PROPERTY	Local rate times assessed value											
SALES	Fixed state sales tax times purchases of goods and services											
INCOME	Federal-State tax plus local tax, if any											
31. RATE OF RETURN	Net income divided by sum of business value and land value											
32. UNITS OF POLLUTION PER MG												
BOD (LBS/MG)	600	500	1000	500	400	800	500	6000	6000	3000	2000	100
CHLORIDES (LBS/MG)	100	100	170	150	150	200	180	400	130	380	600	0
NUTRIENTS (LBS/MG)	1000	1000	500	700	100	200	100	10000	4000	3000	800	0
COLIFORM (Parts/MG)	20	10	20	30	20	20	30	300	20	150	50	20
TEMPERATURE DEVIATION	9	0	6	0	0	0	0	9	18	16	4	0
OIL & FLOATING SOLIDS	1	0	1	1	0	0	0	1	1	1	1	0
HIGH LEVEL WASTES	0	0	0	0	0	0	0	0	1	1	1	0
33. INTAKE TREATMENT COSTS PER MG (dollars)												
QUALITY OF WATER												
1	10	NA	20	NA	NA	NA	NA	50	20	20	30	NA
2	60	NA	60	NA	NA	NA	NA	60	60	60	60	NA
3	80	NA	80	NA	NA	NA	NA	80	80	80	80	NA
4	100	NA	100	NA	NA	NA	NA	100	100	100	100	NA
5	180	NA	180	NA	NA	NA	NA	180	180	180	180	NA
6	300	NA	300	NA	NA	NA	NA	300	300	300	300	NA
7	450	NA	450	NA	NA	NA	NA	450	450	450	450	NA
8	600	NA	600	NA	NA	NA	NA	600	600	600	600	NA
9	Cannot be used.											

C. MASTER TABLE FOR COMMERCIAL ESTABLISHMENTS (LEVEL ONE CHARACTERISTICS)

		BG	BS	PG	PS
	LOCATION REQUIREMENTS				
1.	PERCENT OF A PARCEL CONSUMED (Maximum Possible Levels)	12 (8)	10 (10)	12 (8)	12 (8)
2.	ZONING REQUIRED	-- 00 10 30 32	-- 00 10 30 33	-- 00 10 30 34	-- 00 10 30 35
3.	MINIMUM LEVEL OF UTILITY SERVICE (Annual Utility Units Consumed)	2 112	1 71	1 99	1 77
4.	CONSTRUCTION COST (Millions of Dollars)	25	10	30	10
	DEPRECIATION				
5.	ANNUAL PERCENTAGE (Due to Aging)	1.5	2.0	1.6	2.2
6.	MS EFFECT (Maximum Percentage)	2.5	3.0	2.6	3.2
7.	FIRE (Maximum Percentage)				
8.	FLOOD (Maximum Percentage)				
	FLOOD MULTIPLIER	1.5	1.4	1.3	1.2
9.	USE (Percentage at 100% Use)	1.5	2.0	1.6	2.2
	WATER CONSUMPTION				
10.	MILLIONS OF GALLONS PER DAY (MGD)	.13	.17	.23	.18
11.	DAYS WATER IS USED PER YEAR	310	310	310	310
12.	MILLIONS OF GALLONS PER YEAR (MGY)	41	53	72	56
	EMPLOYEES				
13.	FULL TIME POPULATION UNITS (P1's)				
	PH	14	20	8	6
	PM	7	9	13	11
	PL	8	9	23	16
14.	PART TIME (Leisure Time Units)				
	PH	80	80	0	0
	PM	0	0	80	80
	PL	0	0	160	160

		BG	BS	PG	PS
	CAPACITY MEASURES				
15.	MAXIMUM EMPLOYMENT EFFECT	5000	1500	16000	8000
16.	MAXIMUM EFFECTIVE CAPACITY	5000	1500	16000	8000
17.	NORMAL PRICE PER CAPACITY UNIT SOLD (Thousands of Dollars)	100	100	10	10
18.	TYPICAL INCOME FROM SALES (Millions of Dollars)	500	150	160	80
	EXPENDITURES				
19.	BUSINESS GOODS (Units)	NA	NA	.037/CU	.03/CU
20.	BUSINESS SERVICES (Units)	NA	NA	.017/CU	.01/CU
	OUTSIDE SERVICE CHARGES (Thousands of Dollars)	83/CU	58/CU	NA	NA
21.	PURCHASES PER 1% MAINTENANCE				
	BG UNITS	NA	NA	2	.75
	BS UNITS	NA	NA	1	.25
	OUTSIDE SERVICE CHARGES (Thousands of Dollars)	250	100	NA	NA
22.	TYPICAL UTILITIES COSTS (Millions of Dollars)	1.12	.71	.99	.77
23.	WATER (Assuming Water Costs = $450)	18135	23715	32085	25110
24.	TRANSPORTATION (Per Unit of Capacity on HY3)				
	TO BG	NA	NA	.0425	.0375
	TO BS	NA	NA	.02	.0125
	TO TERMINAL	1	NA	NA	NA
25.	SALARIES (Full Employment)	Depends upon salary levels offered			
26.	TAXES				
	PROPERTY	Local rate times assessed value.			
	SALES	Fixed state sales tax times purchases of goods and services.			
	INCOME	Federal-state tax plus local tax, if any.			
27.	RATE OF RETURN	Net income divided by sum of building value and land value.			

D. MASTER TABLE FOR RESIDENCES (LEVEL ONE CHARACTERISTICS)

LOCATION REQUIREMENTS	RA	RB	RC
1. PERCENT OF PARCEL CONSUMED	2	2	2
2. (Maximum Possible Levels of Development)	(50)	(50)	(50)
3. ZONING REQUIRED	-- 00 40 41	-- 00 40 42	-- 00 40 43
4. MINIMUM LEVEL OF UTILITY SERVICE REQUIRED	1	1	2
5. (Annual Utility Units Consumed)	(4)	(26)	(117)
CONSTRUCTION FACTORS			
6. COST (Millions of dollars)	1	6	25
7. QUALITY INDEX (When new, equal to or greater than)	40	40	40
DEPRECIATION			
8. ANNUAL (Due to aging)	2.0	3.0	4.0
9. MS EFFECT (Maximum)	2.0	3.0	3.0
10. FIRE (Maximum)	2.0	2.0	2.0
11. FLOOD (Maximum depends upon damage set by director and location on flood plain)			
12. (Flood Multiplier)	(1.1)	(1.0)	(.9)
WATER CONSUMPTION (Depends Upon Occupants)			
13. MGY PER PH	29	25	22
14. MGY PER PM	25	18	11
15. MGY PER PL	11	11	7

	RA	RB	RC
16. NUMBER OF DAYS DURING YEAR WATER IS USED	360	360	360
17. MGD PER PH	.08	.07	.06
18. MGD PER PM	.07	.05	.03
19. MGD PER PL	.03	.03	.02
OCCUPANTS			
20. SPACE UNITS PROVIDED	2	12	50
21. SPACE UNITS DEMANDED:			
PH	2	2	2
PM	1.5	1.5	1.5
PL	1	1	1
RENT PER SPACE UNIT (Thousands of dollars)			
22. MAXIMUM	210	210	210
23. NORMALS FOR VARIOUS CLASSES			
PH	165	165	165
PM	150	150	150
PL	140	140	140
INCOME (Assuming 100% Occupancy) (Thousands of Dollars)			
24. AT MAXIMUM RENT	420	2520	10500
25. AT RENT OF $150,000 PER SPACE UNIT			
PH OCCUPANTS	300	1800	7500
PM OCCUPANTS	300	1800	7500
PL OCCUPANTS	300	1800	7500
EXPENDITURES			
26. MAINTENANCE			
PG UNITS PER 1% MAINTENANCE	.7	4	17
PS UNITS PER 1% MAINTENANCE	.3	2	8
NORMAL TOTAL COSTS PER 1% MAINTENANCE	10	60	250
27. NORMAL UTILITIES CHARGES (Thousands of dollars)	40	260	1170

28. TAXES

PROPERTY (Local rate times assessed value)
INCOME (Federal-state tax plus local tax)
SALES (Local rate times purchases for maintenance)

NET INCOME	Income from rent minus expenditures
RATE OF RETURN	Net income divided by sum of residence value and land value
ENVIRONMENTAL INDEXES	Comprised of pollution index plus residence quality, rent, MS and school use indexes, and taxes or welfare

E. FARM MASTER TABLE

Farm Identification	F1	F2	F3	F4	F5
Percent Increase in Net Income as a Function of the Fertilizer Level					
1	7	8	5	3	2
2	12	16	9	7	5
3	20	25	15	12	9
Pollution of Nutrients (in LBS/MG) as a Function of the Fertilizer Level					
0	40	50	30	20	10
1	80	100	60	40	20
2	160	250	90	80	30
3	320	500	180	160	60

F. PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	(Maximum Possible Levels)	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees			Terminal Units	MS Drain (MS Capacity Units)
						PH	PM	PL		
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

APPENDIX A

Sequence of Computer Print-Out

Although sections of the computer output can be distributed in any order and in any combination to players, it is printed in a fixed order with which the director should become familiar. The overall order of output is:

1. Migration
2. Water System
3. Employment
4. Commercial Allocation
5. Social Sector
6. Economic Sector
7. Social and Economic Summaries
8. Government Detail
9. Summary Statistics
10. Maps

Within each of these major output sections there are several subsections. An additional section of print-out results from the processing of decisions on a data base. That print-out, called EDIT, has no fixed sequence within it; the order of decision input is the order in which EDIT processes and lists player and director decisions. The EDIT print-out is separate from the print-outs listed above. These print-outs reflect the simulated region's status in response to the previous year's data base and any changes made to it through EDIT.

Each subsection of output has its own title, but on every subsection the heading for the data base and the round number are printed. A list of the titles of print-out sections in the order in which they are printed and a description of each are given below and are summarized in Figure 4.

Print-Out Section	Description
1. Migration	
Environmental Indexes	For each class which can live on each residence parcel, this shows the value of each component of the environmental index based on last round's pollution index, MS use index and school use index and this round's residence quality, rent, tax rates, and welfare rates.

Figure 4

RIVER BASIN MODEL OUTPUT

1. Migration
    - 1.1 Environmental Indexes
    - 1.2 Personal Indexes
    - 1.3 Dissatisfaction Cutoffs
    - 1.4 Migration Detail
    - 1.5 Migration Statistics
    - 1.6 Migration Summary

2. Water System
    - 2.1 Water User Effluent Content
    - 2.2 River Quality During Surface Water Process
    - 2.3 Water User Costs and Consumption
    - 2.4 Coliform and Pollution Index Values

3. Employment
    - 3.1 Employment Selection Information for PL Class
    - 3.2 Employment Selection Information for PM Class
    - 3.3 Employment Selection Information for PH Class
    - 3.4 Part-Time Work Allocation for PH Class
    - 3.5 Part-Time Work Allocation for PM Class
    - 3.6 Part-Time Work Allocation for PL Class
    - 3.7 Employment Summary

4. Commercial Allocation
    - 4.1 Personal Goods Allocation Summary
    - 4.2 Personal Services Allocation Summary
    - 4.3 Business Goods Allocation Summary
    - 4.4 Business Services Allocation Summary
    - 4.5 Government Contracts
    - 4.6 Terminal Demand and Supply Table
    - 4.7 Terminal Allocation Map

5. Social Sector
    - 5.1 Dollar Value of Time
    - 5.2 Social Decision-Maker Output
    - 5.3 Social Boycotts

6. Economic Sector
    - 6.1 Farm Output
    - 6.2 Residence Output
    - 6.3 Basic Industry Output
    - 6.4 Commercial Output
    - 6.5 Economic Boycott Status
    - 6.6 New Construction Table
    - 6.7 Land Summary
    - 6.8 Loan Statement
    - 6.9 Financial Summary

7. Social and Economic Summaries
    - 7.1 Number of Levels of Economic Activity Controlled by Teams
    - 7.2 Employment Centers
    - 7.3 Economic Control Summary for Teams
    - 7.4 Social Control Summary for Teams
    - 7.5 Social Control Summary Totals
    - 7.6 Economic Graphs for Teams
    - 7.7 Social Graphs for Teams

8. Government Detail
    - 8.1 Assessment Report
    - 8.2 Water Department Reports
    - 8.3 Sampling Station Report: Point Source Quality
    - 8.4 Sampling Station Report: Ambient Quality
    - 8.5 Utility Department Report
    - 8.6 Utility Department Finances
    - 8.7 Municipal Services Department Report
    - 8.8 Municipal Services Department Finances
    - 8.9 Municipal Services Department Construction Table
    - 8.10 Planning and Zoning Department Report
    - 8.11 School Department Report
    - 8.12 School Department Finances
    - 8.13 School Department Construction Table
    - 8.14 Highway Department Finances
    - 8.15 Highway Department Construction Table
    - 8.16 Rail Company Report
    - 8.17 Bus Company Report
    - 8.18 Chairman Department Finances
    - 8.19 Tax Summary
    - 8.20 Financial Summary

9. Summary Statistics
    - 9.1 Demographic and Economic Statistics

10. Maps
    - 10.1 Personal Goods Allocation Map
    - 10.2 Personal Services Allocation Map
    - 10.3 Business Commercial Allocation Map
    - 10.4 Municipal Service Map
    - 10.5 School Map
    - 10.6 Utility Map
    - 10.7 Water Usage Map
    - 10.8 Water Quality Map
    - 10.9 Municipal Treatment
    - 10.10 Municipal Intake and Outflow Point Map
    - 10.11 Surface Water Map
    - 10.12 Farm Runoff Map
    - 10.13 River Basin Flood Plain Map
    - 10.14 Farm Map
    - 10.15 Farm Assessed and Market Value Map
    - 10.16 Market Value Map
    - 10.17 Assessed Value Map
    - 10.18 Economic Status Map
    - 10.19 Highway Map
    - 10.20 Planning and Zoning Map
    - 10.21 Parkland Usage Map
    - 10.22 Socio-Economic Distribution Map
    - 10.23 Demographic Map
    - 10.24 Social Decision-Maker Map
    - 10.25 Topographical Restriction Map
    - 10.26 Government Status Map

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Print-Out Section	Description
Personal Indexes	For each class living on each residence parcel, this shows the value of each component of the personal index based on last round's time allocation, residential crowding, MS use index, and coliform bacteria index.
Migration Detail	For each residence parcel and for each class which lived on the parcel immediately before or after the migration program ran, this shows the number of Pl's in the class now residing on the parcel and of those who moved, why they moved and where they came from and went to.
Migration Statistics	Number of in-migrants, out-migrants, internal migrants, and natural population growth by jurisdiction and class.
Migration Summary	The number of Pl's who moved between or within jurisdictions by class, by jurisdiction and by reason for moving.
2. Water System	
Water User Effluent Content	For each economic activity and municipal water system, the volume of effluent dumped into the surface water and the amount of each pollutant in the effluent after the effluent has received any treatment.
River Quality During Surface Water Process	For each of the five stages in the surface water process and for the surface water on each parcel through which a river flows, this shows the water quality rating, the volume of water, and the amount of each pollutant present.

Print-Out Section	Description
Water User Costs and Consumption	This shows for each economic activity the amount of water which it required, the amount which it obtained from its normal source and the cost which it paid to purchase water, to treat its intake water, to recycle water and to treat its effluent.
Coliform and Pollution Index Values	Map showing, for each parcel containing surface water, the coliform count and the water quality rating. The pollution indexes for such parcels and for parcels bordering parcels containing surface water are also shown.
3. Employment	
Employment Selection Information for Low-Income Class	Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the route used to travel to work whether by auto or public transit.
Employment Selection Information for Middle Income Class	Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the routes used to travel to work whether by auto or public transit.

Print-Out Section	Description
Employment Selection Information For High Income Class	Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the routes used to travel to work whether by auto or public transit.
Part-Time Work Allocation For High Income Class	Tabular list of residence location of part-time workers, their employers, the number of part-time units spent working, and the yearly salary rate.
Part-Time Work Allocation for Middle Income Class	Tabular list of residence location of part-time workers, their employers, the number of part-time time units spent working and the yearly salary rate.
Part-Time Work Allocation for Low Income Class	Tabular list of residence location of part-time workers, their employers, the number of part-time time units spent working and the yearly salary rate.
Employment Summary	Information by class and total for the number of Pl's employed at their design level or at lower levels, the number unemployed, the total number of Pl's, the part-time units worked, and the number of jobs full time that were not filled by the local labor force.

4. Commercial Allocation

Personal Goods Allocation Summary	Tabular output showing the identification number assigned to each PG establishment, its

Print-Out Section	Description
	location, owner, level, effective capacity, actual capacity used, price, and gross sales. For each customer it shows the store to which it is assigned, the customer location and type or class, the customer's owner, the consumption units (including those for maintenance and recreation), transportation costs (shadow costs in the case of residences) the purchase cost (total cost in the case of residences), and total cost.
Personal Services Allocation Summary	This is identical in format to the Personal Goods Allocation Summary but gives details regarding personal services.
Business Goods Allocation Summary	For businesses which require business goods, the format is the same as for personal goods. In addition, there is a section called Government Contracts which shows, for each school and MS department, how many consumption units it purchases from each business goods establishment.
Business Services Allocation Summary	This is identical in format to the Business Goods Allocation Summary but gives details regarding business services.
Terminal Allocation Summary	Tabular list of the location, business type (land use), and terminal requirements of each terminal user. Each terminal is assigned an identification number and its location, level, and usage are noted.

Print-Out Section	Description
Terminal Allocation Map	Map showing the code number of the terminal to which each terminal user in the local system is assigned.
5. Social Sector*	
Dollar Value of Time	This table shows, by team and by class, the dollar value of a time unit spent in travel.
Social Decision-Maker Output	By jurisdiction, by social decision-maker, and by class, a table in which each social characteristic is a row and each residence parcel is a column. The characteristics are descriptive and financial.
Social Boycotts	Detail on who is boycotting, what function they are boycotting, and similar details about social boycotts appear on this output.
6. Economic Sector**	
Farm Output	Tabular list, one row per farm, showing the farm code number, farm type, number of parcels comprising the farm, number of percents of parcels comprising the farm, the farm's fertilizer level, normal income, actual income, land taxes, and total net income.

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*The dollar value of time prints a table for each jurisdiction, although at this time the value is set for a team and class without regard to jurisdiction. The rest of the social detail prints in order of jurisdiction number, within that in alphabetical order, and within that in order of class (low first, high last). Output for any classes which a team does not control in a jurisdiction is not printed. Likewise, a class having no boycotts receives no boycott output.

**The economic output prints by team in alphabetical order. All of a single team's output is printed before the next team's output begins. A team for which a section of output is irrelevant does not receive that section of output. For example, a team with no residences receives no residence output. Likewise, a team which has no loans outstanding as either a debtor or a creditor does not receive a loan summary. All active teams receive financial summaries.

Print-Out Section	Description
Residence Output	Tabular list of descriptive and financial information about each residence parcel which the decision-maker controls.
Business Output	Tabular list of descriptive and financial information about each business which the decision-maker controls. All basic industries are grouped together and precede the group of personal commercial and business commercial.
Construction Industry Output	Tabular list of descriptive and financial information about each construction industry which the decision-maker controls.
Construction Industries' Contract Table	Description of all contracts made by construction industries controlled by the decision-maker.
Economic Boycott Status	Detail on all boycotts in which the decision-maker is either the party boycotting or the party being boycotted.
New Construction Table	Detail on all construction contracts in which the decision-maker is the contractee.
Land Summary	Tabular list of the location of parcels owned by a team, their assessed value, percent that is undeveloped and private, the taxes on undeveloped land, the percent publicly developed and undeveloped, the percent undevelopable because of topographical constraints, the utility capacity available and used.

Print-Out Section	Description
Loan Statement	Tabular list showing borrower, lender, interest rate, years remaining on the loan, the original principal, and the annual payment.
Financial Summary	A cash flow statement showing expenditures and income, a portfolio of conservative and speculative stocks, a balance sheet of assets and liabilities, and the amount which the decision-maker can borrow.
7. Social and Economic Summaries	
Number of Levels of Economic Activity Controlled by Teams	A table listing the number of levels of each economic activity controlled by each team.
Employment Centers	Table showing the locations, number of job openings, number of P1's hired, and salaries offered by Federal-State Employers; table showing, for each local government employer, the location of its employment center.
Economic Control Summary*	For each non-farm economic activity, this table shows its location, type and operating level of activity, production index (0-100) or occupancy rate (0-120), net income, and rate of return.

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*This table prints for each economic team in alphabetical order.

Print-Out Section	Description
Social Control Summary*	For each class living on each parcel controlled by a single two-letter social decision-maker, this table shows the residence location, class, gross income per worker, family savings and total dissatisfaction (quality of life index).
Social Control Summary	By jurisdiction and by class, the number of P1's controlled by each social decision-maker.
Economic Control Summary	This prints two graphs for each economic decision-maker, in alphabetical order. The first is, for up to ten rounds, the average net income from the team's economic activities each round, expressed as a ratio of the first round's net income. The second is a ten-round history of the average rate-of-return of the team's economic activities, expressed as a percent.
Social Control Summary	This prints two graphs for each social decision-maker, in alphabetical order. The first is a ten-round history of the average net income earned by each class which the team has controlled. The second is a ten-round history of the average quality-of-life index of each class which the team has controlled.

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*This table prints for each social decision-maker in alphabetical order.

Print-Out Section	Description
8. Government Detail*	
Assessment Report	List of assessment ratios, special assessments and other policies set by the Assessor.
Water Department Reports	List of intake and outflow treatment plant locations, levels, types, capacities, operating costs, volume treated, income, intake and outflow point locations, prices charged to municipal water users, pollutant concentration in municipal effluent (for those districts which are sampled).
Sampling Station Report: Point Source Quality	For those economic activities whose effluent is sampled by the local government, this shows the volume of effluent and the concentration of each pollutant after any treatment.
Sampling Station Report: Ambient Quality	For any parcel on which the jurisdiction measures the quality of the surface water leaving the parcel, this output shows the concentration of each pollutant.
Utility Department Report	Tabular list of utility plants, their location, level, units installed from each plant, units served, total operating costs per unit, and income derived from charges. Also listed is the charge per utility unit to customers, undeveloped land and outstanding bonds.

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*A department's output is printed for all jurisdictions before the next department's output is printed.

Print-Out Section	Description
Utility Department Finances	Summary of all current and capital revenues, expenditures, and new balances.
Municipal Services Department Report	Tabular list of MS locations, maintenance levels, value ratios, effective capacities, loading (units of capacity used), number PL and PM's working, and the MS use indexes. Also shown are the salary levels, contracts to purchase BG and BS, the locations of undeveloped land, and outstanding bonds.
Municipal Services Department Finances	Summary of all current and capital revenues, expenditures, and new balances.
Municipal Services Department Construction Table	For each MS construction or demolition, this shows the location of the construction firm, the MS location, the status of construction, the old and new level of the MS, the contracted price, the maintenance level, and the number of PL's and PM's assigned to work at the MS.
Planning and Zoning Department Report	Total jurisdiction population, total amount of parkland, outstanding bonds, and capital revenues, expenditures, and new balance.
School Department Report	Tabular data on school unit locations, levels, maintenance levels, value ratios, students attending, teachers, student-teacher ratios, and use indexes. Also data on undeveloped land, BG and BS contracts and cost of purchases, adult education summary, and several summary school statistics.
School Department Finances	Summary of all current and capital revenues, expenditures, and new balances.

Print-Out Section	Description
School Department Construction Table	For each school construction or demolition, this shows the location of the construction firm, the school building location, the status of construction, the old and new level of the school, the contracted price, the amount of federal-state aid used, the maintenance level for the school, and the number of PM's and PH's assigned to work at the School.
Highway Department Report	A financial report showing capital and current expenditures and revenues, outstanding bonds, a summary of maintenance levels and expenditures by road type, a summary of road conditions, a terminal status report, a list of undeveloped land, and a status report on available federal-state aid.
Highway Department Construction Table	For each road or terminal construction or demolition, this shows the construction firm, the location of the road or terminal, the status, the old and new level, the contracted price, and the dollar amount of federal-state aid used.
Rail Company Report	A financial report showing capital and current revenues and expenditures, outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers using each segment of each route.

Print-Out Section	Description
School Department Construction Table	For each school construction or demolition, this shows the location of the construction firm, the school building location, the status of construction, the old and new level of the school, the contracted price, the amount of federal-state aid used, the maintenance level for the school, and the number of PM's and PH's assigned to work at the School.
Highway Department Report	A financial report showing capital and current expenditures and revenues, outstanding bonds, a summary of maintenance levels and expenditures by road type, a summary of road conditions, a terminal status report, a list of undeveloped land, and a status report on available federal-state aid.
Highway Department Construction Table	For each road or terminal construction or demolition, this shows the construction firm, the location of the road or terminal, the status, the old and new level, the contracted price, and the dollar amount of federal-state aid used.
Rail Company Report	A financial report showing capital and current revenues and expenditures, outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers using each segment of each route.

Print-Out Section	Description
Bus Company Report	A financial report showing capital and current revenues and expenditures, outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers using each segment of each route.
Chairman Department Finances	This shows the welfare payment per unemployed worker and the financial summaries for municipal services, schools, highways, planning and zoning, utilities, and the chairman's account. Also included are the Chairman's outstanding bonds.
Tax Summary	Tabular list showing by the eight types of local tax bases, the dollar amount of the tax base, the tax rate, and the revenue generated.
Financial Summary	Tabular list, for each department, of current and capital appropriations, federal-state aid, total revenue, total expenditures and final surplus or deficit.
9. Summary Statistics	
Demographic and Economic Statistics	Tabular list by jurisdiction of population and its characteristics, land usage, housing, employment, earnings, income from the national economy, outflows to the national system, and national business cycle effects.

Print-Out Section	Description
10. Maps	
Personal Goods Allocation Map	Map showing the locations and code numbers of all personal goods establishments, locations of all PG users, and the code number of the PG to which each PG user is assigned.
Personal Services Allocation Map	Map showing the locations and code numbers of all personal services establishments, locations of all PS users, and the code number of the PS to which each PS user is assigned.
Business Commercial Allocation Map	Map showing the locations and code numbers of all business goods and business services establishments, locations of all BG and BS users, and the code numbers of the BG and BS to which each BG and BS user is assigned.
Municipal Service Map	Map showing the locations of MS's and their districts, the locations of economic activities, the number of MS units drained by each economic activity and MS use indexes.
School Map	Map showing the locations of schools and their districts, school use indexes, and the number of children on each residence parcel attending public and private schools.
Utility Map	Map showing the locations of utility plants and their districts, the number of utility units installed on each parcel, and the number of utility units drained on each parcel.

Print-Out Section	Description
Water Usage Map	Map showing the locations of economic activities, the percent recycling at basic industries, and the type and level of basic industries' effluent treatment plants.
Water Quality Map	Map showing the locations of economic activities, the surface water quality on those parcels having surface water, and the pollutant which caused the water quality rating.
Municipal Treatment Plant Map	Map showing locations, types and levels of municipal intake and outflow treatment plants.
Municipal Intake and Outflow Point Map	Map showing locations of municipal intake and outflow points and the utility districts which they serve.
Surface Water Map	Map showing, for each parcel having surface water, the volume of water on the parcel, its rate of flow, and the percent of the surface area of the parcel consumed by water.
Farm Funoff Map	Map showing for each farm its type and where its runoff flows into the surface water.
River Basin Flood Plain Map	Map showing the locations of river basins, the dam priority of each river basin, and the flood susceptibility of each parcel in the river basin.
Farm Map	Map showing the location of each farm, its owner, its code number, the percent of each farm parcel which is in farm use, the type of farm, and its fertilizer level.

Print-Out Section	Description
Farm Assessed and Market Value Map	Map showing, for each farm parcel, its assessed and market value and the percent of the parcel which is in farmland.
Market Value Map	Map showing, for each privately-owned non-farm parcel, the market value of 100% of the land, the market value of the privately-owned buildings, and the total market value of the privately-owned land and buildings.
Assessed Value Map	Map showing, for each privately-owned non-farm parcel, the assessed value of the privately-owned land, the assessed value of the privately-owned buildings, and the total assessed value of the privately-owned land and buildings.
Economic Status Map	Map showing the economic sector owner of each privately-owned non-farm parcel, its zoning, the type and level of economic activity, the level of utilities installed, and, for every parcel, the percent of the parcel which is privately-owned and undeveloped.
Highway Map	Map showing the locations and types of roads and terminals and the locations, types, and levels of non-farm economic activities.
Planning and Zoning Map	Map showing the zoning classification of those parcels which are zoned, the percent of each parcel which is parkland, and the percent of each parcel which is public institutional land.

Print-Out Section	Description
Parkland Usage Map	Map showing the percent of each parcel which is in parkland or public institutional use, the population served by the park, and the park's use index.
Socio-Economic Distribution Map	Map showing, for each residential parcel, the type and level of housing and the number of Pl's in each class living there.
Demographic Map	Map showing the population (in 100's), percent occupancy, and quality index (QI) for all residential parcels, and the value ratio (VR) for all private non-residential developments.
Social Decision-Maker Map	Map showing, for each class living on a residential parcel, the social decision-maker which controls the class on that parcel.
Topographical Restriction Map	Map showing the percent of each parcel which is undevelopable due to topographical or other restrictions (e.g., mountains or military bases).
Government Status Map	Map showing the locations and levels of schools, municipal services, utility plants, roads, and terminals.

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